d. Install no more than 50 addressable devices on each signaling line circuit.

D. Notification Appliance Circuit: Operation shall sound in a Temporal Pattern.

E. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm receiver at the Baltimore Harbor Tunnel Administration Building.

F. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

G. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed lead calcium.

H. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.

2. Station Reset: Key- or wrench-operated switch.

2.5 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.

2. Detectors shall be four-wire type.

3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.

5. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.

2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

a. Primary status.

b. Device type.

c. Present average value.

d. Present sensitivity selected.

e. Sensor range (normal, dirty, etc.).

2.6 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.

2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.7 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- high letters on the lens.

1. Rated Light Output:

a. 15, 30, 75, 110 cd.

2. Mounting: Wall mounted unless otherwise indicated.

3. Flashing shall be in a temporal pattern, synchronized with other units.

4. Strobe Leads: Factory connected to screw terminals.

5. Mounting Faceplate: Factory finished red.

2.8 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.

1. Mounting: Surface cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.9 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.

2.10 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.

2. Address of the supervisory signal.

3. Address of the trouble-initiating device.

4. Loss of ac supply or loss of power.

5. Low battery.

6. Abnormal test signal.

7. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.

B. Equipment Mounting: Install fire-alarm control unit on finished floor with tops of cabinets not more than 72 inches above the finished floor.

C. Smoke- or Heat-Detector Spacing:

1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.

2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.

3. Smooth ceiling spacing shall not exceed 30 feet.

4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A in NFPA 72.

5. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.

6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.

D. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

E. Visible Alarm-Indicating Devices: Install adjacent to each alarm horn and at least 6 inches below the ceiling.

F. Device Location-Indicating Lights: Locate in public space near the device they monitor.

G. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches above the finished floor.

H. Annunciator: Install with top of panel not more than 72 inches above the finished floor.

3.2 CONNECTIONS

A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Supervisory connections at standby generator for run and fault conditions.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.4 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. The completed Fire Alarm System shall be Acceptance Tested in the presence of a Representative from the Maryland State Fire Marshall's Office.

2. Visual Inspection: Conduct visual inspection prior to testing.

a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.

b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

3. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

4. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.

5. Test visible appliances for the public operating mode according to manufacturer's written instructions.

6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form"

in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

E. Fire-alarm system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

PART 4 – MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. No separate measurement will be made for work under this section.

PART 5 – PAYMENT

5.1 BASIS OF PAYMENT

A. No separate payment will be made for work under this section. The cost of the work described in this section shall be included in the respective Lump Sum Bids under:

Item 011010-01 Western Facility Operations Building–per lump sum

Item 011010-02 Western Facility Police Building–per lump sum

Item 011010-03 Western Facility Storage Building–per lump sum

B. Costs include all labor, materials, services, testing and equipment necessary to complete the work in every respect.

END OF SECTION 283111

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Maryland State Highway Administration (MDSHA) Standard Specifications for Construction and Materials, issued January 2001, with all of the latest addenda, are to be used for this section, except as modified here.

1.2 SUMMARY

A. This Section includes the following:

1. Clearing and grubbing.

2. Stripping and stockpiling topsoil.

B. Related Sections include the following:

1. Section 311500 - Erosion and Sediment Control.

2. Section 312000 - Earthwork.

3. Section 312500 - Finish Grading for Lawns and Planting Areas.

1.3 MATERIAL OWNERSHIP

A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.4 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from the Engineer and authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining the Authority's property will be obtained by the Engineer before award of Contract.

1. Do not proceed with work on adjoining property until directed by the Engineer.

C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

D. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Existing Utilities: Do not interrupt utilities serving facilities by others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Engineer not less than 72 hours in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without the Engineer's written permission.

3.2 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, heavy grass, other vegetation, and tree stumps to permit installation of new construction.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Refer to Section 312000 for suitable fill materials.

2. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.3 TOPSOIL STRIPPING

A. Remove remaining grass and root mat before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.4 DISPOSAL

A. All materials removed during clearing and grubbing operations shall be taken off the Authority's Property and legally disposed.

B. Remove surplus soil material, unsuitable topsoil, grass and rot mat, demolished materials, and waste materials including trash and debris, and legally dispose of them off the Authority's property.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. Clearing and grubbing will not be measured for payment.

B. Stripping of topsoil over the entire site property will be measured by the cubic yard.

PART 5 - PAYMENT

5.1 BASIS OF PAYMENT

A. Payment for clearing and grubbing shall be made at the Contract lump sum price, accepted as complete for the entire site by the Engineer. This shall be considered full compensation for all materials, labor, services, equipment, tools and incidentals

necessary to complete the work covered by this Section and other relating project documents.

Payment will be made under:

Item 311000-1 Clearing and Grubbing--per lump sum

B. Payment for stripping of topsoil shall be made at the Contract bid price per cubic yard. This shall be considered full compensation for all clearing, excavating, screening, hauling, stockpiling of suitable topsoil material, and disposal of unsuitable material, and for all labor, services, equipment, tools, and incidentals necessary to complete the work covered by this Section and other relating project documents.

Payment will be made under:

Item 311000-2 Stripping of Topsoil--per cubic yard.

C. No additional payment shall be made for reconditioning graded areas.

END OF SECTION 311000

SECTION 311500 - EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Maryland State Highway Administration (MDSHA) Standard Specifications for Construction and Materials, issued January 2001, with all of the latest addenda, are to be used for this section, except as modified here.

1.2 SUMMARY

A. This item shall consist of furnishing, installation, continuous maintenance and subsequent removal of temporary erosion and sediment control measures during the life of the contract at locations indicated on the Contract Drawings. The work under this item shall include but not necessarily be limited to furnishing, installation, maintenance and subsequent removal of approved measures for protection of stormwater inlets, manholes, and water courses and the installation and subsequent removal of stabilized construction entrances.

B. Areas requiring temporary air and water pollution, soil erosion and siltation control shall be determined by the Engineer and will be discussed at each pre-construction conference. The Contractor shall be responsible for the development and implementation of pollution control devices in accordance with these specifications and directives of the Engineer.

C. The Contractor shall be responsible for immediate and unconditional implementation of pollution control devices at the request of the Engineer in order to minimize contamination of adjacent rivers or other water courses, or other areas of water impoundment.

D. In the event that temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install appropriate permanent controls as part of the work as scheduled or ordered by the Engineer, such work shall be performed by the Contractor at the Contractor's expense.

E. The pollution control devices installed by the Contractor shall be acceptably and continuously maintained by the Contractor during construction periods or periods of construction shutdowns. The Engineer may decrease or increase the area of erodible earth material to be exposed at one time as determined by analysis of project conditions.

F. Pollutants such as fuels, lubricants, bitumen, raw sewage, wash-water from concrete mixing operations, and other harmful materials shall not be discharged into or near rivers, streams, and impoundments, or into natural or manmade channels leading thereto. The Contractor shall be liable for damages and expenses associated with clean-up of all contaminations resulting from the Contractor's operations.

1.3 REFERENCES

A. The Maryland Department of Transportation, Maryland State Highway Administration (MDSHA) Standard Specifications for Construction and Materials, January 2001, and all current supplements, unless specified otherwise by the Engineer.

B. The Maryland Standards and Specifications for Soil Erosion and Sediment Control, 1994 Edition.

C. General Sediment Control Notes, Vegetative Stabilization Notes, and Erosion and Sediment Control Details indicated on the Contract Drawings.

1.4 SUBMITTALS

A. Prior to start of construction in areas requiring pollution control devices, the Contractor shall submit schedules for accomplishment of temporary and permanent erosion control work, as are applicable for grading, paving, and structures at water courses and points receiving polluted water from the construction area(s). Work in areas requiring pollution control devices shall not begin until the pollution control schedules and methods of operation for each area have been submitted and approved by the Engineer.

1.5 PERMITS

A. The Administration is responsible for obtaining all permits. If the Contractor revises the plans, it is the Contractor's responsibility to get the revisions to the permit.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials to be used in construction of temporary sediment and erosion control measures shall be in accordance with and governed by the requirements of the Maryland Standards and Specifications for Soil Erosion and Sediment Control, 1994 Edition, and the applicable sections of the MDSHA Standard Specifications for

Construction and Materials, January 2001, and all current supplements to the MDSHA Standard Specifications, unless specified otherwise by the Engineer.

2.2 STONE

A. Stone for construction of stabilized construction entrance structures shall conform to requirements of AASHTO M 43, Size No. 1 or No. 2.

B. Stone for inlet protection shall conform to the requirements of AASHTO M 43, Size No. 2.

2.3 FABRIC

A. Fabric grades indicated on the referenced Soil Erosion and Sediment Control Standards and the Contract Drawing Details, including but not limited to stabilized construction entrance, inlet protection, silt fence and diversion fence, shall conform to the requirements of Article 921.09 of the MDSHA Standard Specifications, or as otherwise indicated on the Drawing Details.

2.4 TEMPORARY SEED AND MULCH

A. Temporary seed and mulch, and any additional stabilization measures required, shall conform to the Vegetative Stabilization Notes indicated on the Contract Drawings

PART 3 - EXECUTION

3.1 GENERAL SOIL EROSION AND SEDIMENT CONTROL METHODS

A. For method of construction to be employed in the prosecution of work under this item, the Contractor shall refer to the 1994 Edition of the "Maryland Standards and Specifications for Soil Erosion and Sediment Control," published jointly by the Water Resources Administration, USDA Soil Conservation Service, and the State Soil Conservation Committee, and the applicable sections of the Maryland Department of Transportation, Maryland State Highway Administration Standard Specifications for Construction and Materials, January 2001, and current supplements, all subject to the Engineer's modification and approval.

B. Typical construction details for several pollution control devices are included in the Contract Drawings. These details are not considered inclusive of all conditions that may develop as a result of or during construction. In the absence of an applicable construction detail for measures required by the Engineer, the Contractor is hereby directed (a) to refer to the specifications cited under this item for additional details,

or (b) will be provided with appropriate details for the specific condition by the Engineer. Under no circumstances shall the Contractor begin construction without construction drawings indicating limits and details of work as provided by the Engineer.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. Measurement of erosion and sediment control work items shall be made in accordance with Sections 308, 312, 704 and 705 of the MSHA Standard Specifications, unless otherwise modified herein.

B. Reconstruction, resetting or rehabilitation of sediment and erosion control work, other than cleanout excavation, shall not be measured.

C. No measurement for payment shall be made under this section for excavating the designated areas of the SWM Facility designated on the Contract drawings that will also function as temporary sediment basins.

D. Other devices, additives, and measures not included or specifically mentioned herein, but necessary for the execution of governing regulations and standards and the Engineer's directives will not be measured for direct payment. Performance of this work shall be considered incidental to and as a subsidiary obligation of the Contractor to complete the work.

E. No measurement for payment will be made for unauthorized and unapproved work, controls installed beyond limits designated by the Engineer, controls not maintained by the Contractor, and work not conforming to governing standards and regulations.

PART 5 – PAYMENT

5.1 BASIS OF PAYMENT

A. Payment for the erosion and sediment control items noted below, accepted as complete in place, shall be made at the Contract unit prices bid. Payment shall be considered full compensation for all the work described in this Section and shown on the Contract Drawings, and shall include all labor, materials, services, and equipment necessary to complete the work in every respect to the satisfaction of the Engineer.

B. Materials for payment shall include any supplementary materials needed to stabilize the ground or anchor erosion and sediment control measures in place as noted on the Contract Drawings and the referenced Standards.

C. Payment shall be made under:

Item 311500-1	Diversion Fence--per linear foot.
Item 311500-2	Perimeter Dike Swale--per linear foot
Item 311500-3	Stabilized Construction Entrance--per ton
Item 311500-4	Temporary Stone Outlet Structure--per each
Item 311500-5	Super Silt Fence--per linear foot
Item 311500-6	Median Inlet Protection--per each
Item 311500-7	Temporary Draw-Down Device--per each
Item 311500-8	Erosion & Sediment Control Cleanout Excavation--per cubic yard
Item 311500-9	Temporary Seeding--per pound
Item 311500-10	Temporary Mulching--per ton
Item 311500-11	Portable Sediment Tank--per each
Item 311500-12	Class I Riprap for Sediment Control--per ton
Item 311500-13	Temporary 15-Inch Reinforced Concrete Pipe for Sediment Control--per linear foot
Item 311500-14	Earth Dike, Type A-2--per linear foot

D. Payment for reconstruction, resetting or rehabilitation of sediment and erosion control work, other than cleanout excavation work, shall be taken to be included in and covered by the respective Contract unit prices bid for all sediment and erosion control items, unless specified otherwise.

END OF SECTION 311500

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SECTION 312000 - EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Maryland State Highway Administration (MDSHA) Standard Specifications for Construction and Materials, issued January 2001, with all of the latest addenda, are to be used for this section, except as modified here.

1.2 SUMMARY

A. This Section includes the following:

1. Excavating and backfilling for buildings and structures.
2. Drainage course for pavements and slabs-on-grade.
3. Excavating and backfilling for utility trenches.
4. Excavating and backfilling for graded slopes and landscaping areas.

B. Preparing subgrades for walks, pavements and lawns and grasses shall be constructed in accordance with Section 208 of the Maryland State Highway Administration (MDSHA), Standard Specifications for Construction and Material, January 2001 Edition, with the latest revisions issued on or before the date of advertisement of the Contract.

C. Related Sections include the following:

1. Section 311000 - Site Clearing.
2. Section 311500 - Erosion and Sediment Control.
3. Section 312500 - Finish Grading for Lawns and Planting Areas.
4. Applicable sections for installing underground mechanical and electrical utilities, buried mechanical and electrical structures, and storm drain and storm water management systems.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over utility pipe in a trench, including haunches to support sides of pipe.

2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Bedding Course: Course placed over the excavated subgrade in a trench before laying utility pipe.

C. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

D. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

E. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by the Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.

3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect/Engineer. Unauthorized excavation, as well as remedial work directed by Architect/Engineer, shall be without additional compensation.

F. Fill: Soil materials used to raise existing grades.

G. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by an independent geotechnical testing agency, according to ASTM D 1586.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

J. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Each type of plastic warning tape.

B. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D 2487 of each on-site and borrow soil material proposed for fill and backfill.

2. Laboratory compaction curve according to ASTM D 1557 for each on-site and borrow soil material proposed for fill and backfill.

1.5 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.

1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by others unless permitted in writing by the Engineer and then only after arranging to provide temporary utility services according to requirements indicated.

1. Notify the Engineer not less than two days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without the Engineer's written permission.

3. Contact utility-locator service for area where Project is located before excavating.

B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: ASTM D 2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

F. Drainage Course: Narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

2.2 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:

1. Red: Electric.

2. Yellow: Gas, oil, steam, and dangerous materials.

3. Orange: Telephone and other communications.

4. Blue: Water systems.

5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Protect and maintain erosion and sedimentation controls during earthwork operations.

C. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:

a. 24 inches outside of concrete forms other than at footings.

b. 12 inches outside of concrete forms at footings.

c. 6 inches outside of minimum required dimensions of concrete cast against grade.

d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.

e. 6 inches beneath bottom of gradual aggregate base for pavements and concrete slabs on grade.

f. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

3.6 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.

1. Clearance: 12 inches each side of pipe or conduit.

C. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.

1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Excavate below trench bottom line if the Engineer determines under MDSHA Standard Specification Section 201.03.09 that unsuitable material below the line must also be removed.

3.7 SUBGRADE INSPECTION

A. Notify the Engineer when excavations have reached required subgrade.

B. If Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted crusher run aggregate, CR-6, as directed. The undercut may not exceed 3 feet, and should extend 1 foot laterally for every foot in depth. Under no circumstances should the footing be lowered to bear upon more suitable bearing material.

C. Proof-roll subgrade below the building slabs and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.

2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.

3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect/Engineer, and replace with compacted backfill or fill as directed.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect/Engineer, without additional compensation.

3.8 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by the Engineer.

1. Fill unauthorized excavations under other construction or utility pipe as directed by the Engineer.

3.9 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.10 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.

2. Surveying locations of underground utilities for Record Documents.

3. Testing and inspecting underground utilities.

4. Removing concrete formwork.

5. Removing trash and debris.

6. Removing temporary shoring and bracing, and sheeting.

7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.11 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact aggregate material around utility pipes in trenches as indicated on the Typical Pipe Trench Detail in the Contract Drawings. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

1. Carefully compact initial aggregate backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

C. Excavate unsuitable material below trench bottom lines after obtaining concurrence from the Engineer. Replace this additional excavated material with the same aggregate material to be placed around the utility pipes.

D. Place and compact satisfactory embankment material, free of particles larger than 1 inch in any dimension, over the aggregate material in utility pipe trenches or within the excavated trenches for conduits and drain pipes.

E. Backfill trenches excavated under footings to within 18 inches of bottom of footings with satisfactory soil; fill remainder of excavation to elevation of bottom of footings with concrete. Concrete is specified in Division 3 Section "Cast-in-Place Concrete."

F. Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.

G. Backfill voids with satisfactory soil while installing and removing shoring and bracing.

H. Place and compact final backfill of satisfactory soil to final subgrade elevation.

I. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.12 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under steps and ramps, use engineered fill.

2. Under building slabs, use engineered fill.

3. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.13 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.

2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.14 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:

1. If existing subgrade under structures, building slabs and steps is not stable, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.

2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.

3. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.15 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.

2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 1 inch.

2. Walks: Plus or minus 1 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.16 DRAINAGE COURSE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Place drainage course 6 inches or less in compacted thickness in a single layer.

2. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.

3.17 FIELD QUALITY CONTROL

A. Testing Agency: Contractor shall provide the services of a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. Footing Subgrade: Verification and approval of footing subgrades shall be based on a visual inspection of subgrade by Engineer.

D. Testing agency will test compaction of soils in place according to ASTM D 1556 and ASTM D 2922, as applicable. Tests will be performed at the following locations and frequencies:

1. Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 2000 sq. ft. or less of building slab, but in no case fewer than 3 tests.

2. Foundation Wall Backfill: At each compacted backfill layer, at least 1 test for each 100 feet or less of wall length, but no fewer than 2 tests.

3. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 150 feet or less of trench length, but no fewer than 2 tests.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.18 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by the Engineer; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off MdTA's property.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. Site and roadway excavation will be measured by the cubic yard in its original position. No measurement will be made of excavated materials in stockpiles. The costs of stockpiling and rehandling of stockpiled materials shall be taken into account by the Contractor in his bid for Class 1 Excavation.

Measurement shall not include the quantity of materials excavated without authorization beyond normal slope lines, or the quantity of material used for purposes other than those directed.

Measurement for excavation shall be computed by the average end area method. The end area is that bound by the original ground line established by field cross sections and the final theoretical pay line established by excavation cross sections shown on the plans, subject to verification by the Engineer. No deduction will be made for the volume of existing pavement removed. After completion of all excavation operations, the final excavation shall be verified by means of field cross sections taken randomly at intervals not exceeding 200 linear feet.

Final field cross sections shall be employed at every 50-foot station if the following changes have been made:

1. Plan width of embankments or excavations are changed by more than plus or minus 1.0 foot (0.3 meter); or

2. Plan elevations of embankments or excavations are changed by more than plus or minus 0.5 foot (0.15 meter).

B. Excavation for unsuitable material below trench bottom lines, as specified above in Section 312000-3.6-D, will be measured by the cubic yard.

C. Excavation and backfilling for the Stormwater Management Facility will not be measured.

PART 5 - PAYMENT

5.1 BASIS OF PAYMENT

A. A. D. Site and roadway excavation will be paid at the Contract unit price bid per cubic yard. The payment will be full compensation for all excavation and hauling, formation and compaction of embankments and backfills, disposing offsite of excess and unsuitable materials, preparation and completion of subgrade and shoulders except as otherwise specified, serrated slopes, rounded and transition slopes, and for all material, labor, services, equipment, tools, and incidentals necessary to complete the work. Payment will not be made for excavation of any material which is used for purposes other than those designated.

Payment will be made under:

Item 312000-1 Class 1 Excavation -- per cubic yard

B. Unsuitable material excavated below trench bottom lines shall be paid at the Contract unit price bid per cubic yard. Payment shall be considered full compensation for the excavation, hauling, and disposal of the unsuitable material, and for all material, labor, services, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

Item 312000-2 Class 1-A Excavation -- per cubic yard

C. Refer to Section 329500 for payment of the Stormwater Management Facility grading.

D. No additional payment shall be made for reconditioning graded areas.

E. Payment for normal excavation and backfill required for buildings on other structures shall be included in the Contract lump sum bid for the applicable structure.

F. Authorized additional excavation and replacement material for subgrades below building slabs will be paid for according to the Contract provisions for changes in the Work.

G. Payment for normal trench excavation and back fill will be included in the Contract unit price bid for the applicable utility, conduit, or drainage item.

H. Authorized additional replacement material for removed unsuitable material below trench bottom lines shall be paid for according to the Contract provisions for changes in the Work.

END OF SECTION 312000

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SECTION 312500 - FINISH GRADING FOR LAWN AND PLANTING AREAS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Maryland State Highway Administration (MDSHA) Standard Specifications for Construction and Materials, issued January 2001, with all of the latest addenda, are to be used for this section, except as modified here.

1.2 SUMMARY

A. The work covered by this Section includes the furnishing of all material and equipment and the performing of all labor for finish grading of the lawn and planting areas indicated on the Contract Drawings, and as herein specified or directed by the Engineer.

B. The subgrade surface preparation work described under this Section apply to areas outside the Class 1 Excavation limits and the grading limits of the Stormwater Management Facility.

C. Removal of trees, brushes, tree stumps, other vegetation, and heavy grass will be performed during clearing and grubbing operations noted in Section 311000 – Site Clearing.

D. The areas for topsoil placement indicated under this Section shall extend from the pavement limits of the site out to the property lines around the site.

E. The areas for sod placement shall be as noted on the Erosion and Sediment Control plans for permanent stabilization along the Stormwater Management Pond embankment and outfall.

F. Related Sections include the following:

1. Section 311000 - Site Clearing
2. Section 311500 - Erosion and Sediment Control
3. Section 312000 - Earthwork
4. Section 321500 - Cellular Confinement Load Support System
5. Section 329500 - Storm Water Management Facility with Sand Filters.

1.3 SUBMITTALS

A. Soil Test: Topsoil shall be tested for pH, nitrogen, phosphorous, potassium, salts, and organic matter by a recognized soil testing laboratory. Submit results to the Landscape Architect a minimum of seven (7) days prior to construction. Cost of soil testing shall be paid by the Contractor.

PART 2 - PRODUCTS

2.1 TOPSOIL

A. Topsoil stripped from the Site shall be stockpiled for reuse on seed bed and planting bed areas. Remove any roots, stones, clay lumps, soil clods, and any other extraneous material. Should there be insufficient acceptable topsoil stockpiled, the Contractor shall furnish additional topsoil necessary as per established price per cubic yard.

B. Additional new topsoil required to be furnished shall be fertile, friable, natural screened loam containing a minimum of 1.5 percent organic matter. Topsoil shall be free of any admixture of subsoil and shall be free of weeds, roots, stones, clay lumps, soil clods, or any other extraneous debris. It shall be sufficiently fertile to sustain normal, healthy plant growth, and shall have a pH value not higher than 7.0 nor lower than 6.0.

PART 3 - EXECUTION

3.1 FINISH GRADING

A. Subgrade Surface Preparation:

1. Prior to placement of topsoil, remove with a York rake or other mechanical means any debris encountered, including clay lumps, stones, roots, or any other extraneous debris not removed during clearing and grubbing of the site.

2. Plow strip or break up surface to a depth of 2" so that topsoil will bond with existing surface.

3. Subgrade surface shall be graded to ensure positive drainage away from structures and planted areas.

4. Subgrade surface preparation shall extend out to the property line.

B. Topsoil Placement:

1. Spread a minimum 4 inches of stockpiled topsoil in all lawn areas.

2. Place 12" of topsoil in perennial planting beds.

3. Place 6" of topsoil in all shrub planting areas.

4. Smooth finished surface with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

5. Ensure grades drain away from structures to prevent ponding. Finished surfaces shall be free of irregular surface changes exceeding "2 inches.

6. Finished grade surfaces shall be clean and free of debris greater than 1 inch in any dimension. If necessary, finished surfaces shall be hand raked to remove debris.

7. Finished grading work shall not be performed when soil is frozen or wet..

8. Topsoil shall be placed over all exposed areas on the site that will be grassed.

3.2 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Transport acceptable excess topsoil to the existing topsoil storage areas established during Class I Excavation operations. The amount of topsoil stockpiled shall be limited to the amount necessary for backfilling of slopes, berms, lawn areas, and planting areas.

B. Remove waste and excess materials, including unacceptable excavated material, trash, and debris, and dispose of legally off the Owner's property.

3.3 MAINTENANCE

A. Protection of Graded Areas:

1. Protect newly graded areas from traffic and erosion. Refer to Section 311500 – Erosion and Sediment Control. Keep free from trash and debris.

2. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

B. Reconditioning: Where completed areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and provide other corrective measures as required.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. Subgrade surface preparation will be measured per square yard for areas graded and accepted in place.

B. The exception to the above are the areas already covered by the Class 1 Excavation limits under Section 312000, the Stormwater Management Facility grading under Section 329500, and the access roads with the cellular confinement load support system under Section 321500. These areas will not be measured for payment under this Section.

C. Topsoil will be measured per cubic yard installed and accepted in place.

D. Sod and Seeding will be measured per square yard installed and accepted in place.

PART 5 - PAYMENT

5.1 BASIS OF PAYMENT

A. Payment for subgrade surface preparation shall be full compensation for all materials, labor, equipment, tools and incidentals necessary to complete the work covered by this section and other relating project documents. This work will be paid for at the Contract unit price per square yard installed and accepted in place.

Payment will be made under:

Item 312500-1 Subgrade Preparation for Lawn and Planting Areas--per square yard

B. Payment for topsoil shall be full compensation for all materials, labor, equipment, tools and incidentals necessary to complete the work covered by this section and other relating project documents. This work will be paid for at the Contract unit price per cubic yard installed and accepted in place.

Payment will be made under:

Item 312500-2 Topsoil--per cubic yard

C. No additional payment shall be made for reconditioning graded areas.

D. Payment for sod shall be full compensation for all materials, labor, equipment, tools and incidentals necessary to complete the work covered by this section and other relating project documents. This work will be paid for at the Contract unit price per square yard installed and accepted in place.

Payment will be made under:

Item 312500-3 Sod--per square yard

E. Payment for seeding shall be full compensation for all materials, labor, equipment, tools and incidentals necessary to complete the work covered by this section and other relating project documents. This work will be paid for at the Contract unit price per square yard installed and accepted in place.

Payment will be made under:

Item 312500-4 Seeding--per square yard

END OF SECTION 312500

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SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Maryland State Highway Administration (MDSHA) Standard Specifications for Construction and Materials, issued January 2001, with all of the latest addenda, are to be used for this section, except as modified here.

1.2 SUMMARY

A. This Section includes temporary excavation support and protection systems needed for the installation of buildings, structures, utilities, and drainage systems.

1.3 PERFORMANCE REQUIREMENTS

A. Design, furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.

1. Provide professional engineering services needed to assume engineering responsibility, including preparation of Shop Drawings and a comprehensive engineering analysis by a qualified professional engineer.

1.4 SUBMITTALS

A. Shop Drawings for Information: Prepared by or under the supervision of a qualified professional engineer for excavation support and protection systems.

1. Include Shop Drawings signed and sealed by the qualified professional engineer responsible for their preparation. The engineer shall be licensed as a PE in the State of Maryland.

1.5 PROJECT CONDITIONS

A. Survey adjacent structures and improvements, employing a qualified professional engineer or land surveyor; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

1. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and

positions for comparison with original elevations and positions. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that are either new or in serviceable condition.

B. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.

C. Steel Sheet Piling: ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.

D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of 4 inches.

E. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.

F. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.

B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

C. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.

D. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

3.2 REMOVAL AND REPAIRS

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.

1. Remove excavation support and protection systems to a minimum depth of 48 inches below overlying construction and abandon remainder.

2. Repair or replace, as approved by the Engineer, adjacent work damaged or displaced by removing excavation support and protection systems.

B. For the installation of underground fuel tanks only, the excavation support and protection systems must be left permanently in place. Refer to the Contract Drawings for the required top level of sheeting and shoring to be placed around the fuel tanks.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. Excavation support and protection will not be measured.

PART 5 - PAYMENT

5.1 BASIS OF PAYMENT

A. Payment for excavation and support shall not be paid directly, but shall be considered part of the compensation provided for the construction of buildings, structures, utility lines, or drainage systems for which excavation support and protection is needed.

END OF SECTION 315000

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SECTION 321150 – GRADED AGGREGATE BASE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Maryland State Highway Administration (MDSHA) Standard Specifications for Construction and Materials, issued January 2001, with all of the latest addenda, are to be used for this section, except as modified herein.

B. MDSHA Book of Standards for Highway and Incidental Structures, Current Set.

1.2 SUMMARY

A. The work covered by this Section includes the furnishing of all material and equipment and the performing of all labor to complete the construction of graded aggregate base for asphalt and concrete pavement areas as shown on the Contract Drawings and as herein specified or directed by the Engineer.

PART 2 - PRODUCTS.

2.1 GENERAL

A. All materials for graded aggregate base shall be in accordance with MDSHA Standard Specifications Section 501.02.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall construct graded aggregate base in accordance with MDSHA Standard Specifications Section 501.03.

B. Refer to the Contract drawings for the course thickness required under each type of paving.

C. An extended course thickness of graded aggregate base shall be installed under the proposed reinforced concrete pavement located directly over the underground fuel tanks. Refer to the Utility Details in the Contract Drawings.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. Graded aggregate base for 8-inch and 6-inch thick courses will be measured by the square yard in accordance with MDSHA Section 501.04.

B. The graded aggregate base installed over the underground fuel tanks will be measured as layered 8-inch thick courses.

PART 5 - PAYMENT

5.1 BASIS OF PAYMENT

A. Graded aggregate base will be paid for at the Contract unit price bid per square yard in accordance with MDSHA Standard Specifications Section 501.04.

Payment will be made under:

Item 321150-1	Graded Aggregate Base, 8-Inch Thickness -- per square yard
Item 321150-2	Graded Aggregate Base, 6-Inch Thickness -- per square yard

END OF SECTION 321150

SECTION 321216 - HOT MIX ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Maryland State Highway Administration (MDSHA) Standard Specifications for Construction and Materials, issued January 2001, with all of the latest addenda, are to be used for this section, except as modified herein.

1.2 SUMMARY

A. The work covered by this includes the furnishing of all material and equipment and the performing of all labor to construct superpave hot mix asphalt base and surface courses for roadways and facility areas as shown on the Contract Drawings, and as herein specified or directed by the Engineer.

1.3 SUBMITTALS

A. Product Data: For each product specified. Include technical data and tested physical and performance properties.

B. Job Mix Designs: Contractor to provide certification of approval of job mix design by SHA for each job mix proposed for the Work.

C. Job Mix Designs: For each job mix proposed for the Work.

D. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate dedicated handicapped spaces with international graphics symbol.

E. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

F. Material Test Reports: Indicate and interpret test results for compliance of materials with requirements indicated.

G. Material Certificates: Certificates signed by manufacturers certifying that each material complies with requirements.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has completed hot mix asphalt paving similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Manufacturer Qualifications: Engage a firm experienced in manufacturing hot mix asphalt similar to that indicated for this Project and with a record of successful in-service performance.

1. Firm shall be a registered and approved paving mix manufacturer with the MDSHA.

C. Testing Agency Qualifications: Demonstrate to Engineer's satisfaction, based on Engineer's evaluation of criteria conforming to ASTM D 3666, that the independent testing agency has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work. The Contractor shall engage an independent Testing Agency.

D. Regulatory Requirements: Conform to applicable standards of MDSHA.

E. Asphalt-Paving Publication: Comply with AI's "The Asphalt Handbook," except where more stringent requirements are indicated.

F. Pre-installation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings" Review methods and procedures related to asphalt paving including, but not limited to, the following:

1. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot mix asphalt.

2. Review condition of substrate and preparatory work performed by other trades.

3. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

4. Review and finalize construction schedule for paving and related work. Verify availability of materials, paving Installer's personnel, and equipment required to execute the Work without delays.

5. Review inspection and testing requirements, governing regulations, and proposed installation procedures.

6. Review forecasted weather conditions and procedures for coping with unfavorable conditions.

PART 2 - PRODUCTS

2.1 All materials for superpave hot mix asphalt paving shall be in conformance with MDSHA Standard Specifications Section 504.02.

PART 3 - EXECUTION

3.1 Hot mix asphalt paving shall be constructed in accordance with MDSHA Standard Specifications Section 504.03.

3.2 The base course shall be installed as two separately applied layers at the thickness for each layer indicated on the Contract Drawings.

3.3 The surface course shall be installed as one layer at the thickness indicated on the Contract Drawings.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. Hot Mix Asphalt will be measured on the basis of weight of superpave hot mix asphalt furnished, completed and accepted in accordance with MDSHA Standard Specifications Section 504.04.

PART 5 - PAYMENT

5.1 BASIS OF PAYMENT

A. Hot Mix Asphalt Pavement will be paid for at the Contract unit price per ton for each course type as per MDSHA Standard Specifications Section 504.04. Payment will be made under:

Item 321216-1 HMA Superpave for Base Course--per ton

Item 321216-2 HMA Superpave for Surface Course--per ton

END OF SECTION 321216

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SECTION 321315 – REINFORCED CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Maryland State Highway Administration (MDSHA) Standard Specifications for Construction and Materials, issued January 2001, with all of the latest addenda, are to be used for this section, except as modified herein.

1.2 SUMMARY

A. The work covered by this Section includes the furnishing of all material and equipment and the performing of all labor to complete the construction of reinforced concrete pavement around a fuel service island as shown on the Contract Drawings and as herein specified or directed by the Engineer.

PART 2 - PRODUCTS.

2.1 GENERAL

A. All materials for reinforced concrete pavement shall be in accordance with MDSHA Standard Specifications Section 520.02.

PAER 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall construct reinforced concrete pavement in accordance with MDSHA Standard Specifications Section 520.03.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. Reinforced concrete pavement will be measured by the square yard in accordance with MDSHA Section 520.04.

PART 5 - PAYMENT

5.1 BASIS OF PAYMENT

A. Reinforced concrete pavement will be paid for at the Contract unit price bid per square yard in accordance with MDSHA Standard Specifications Section 520.04. Payment will be made under:

Item 321315-1 Reinforced Concrete Pavement--per square yard

END OF SECTION 321315

SECTION 321340 – COMBINATION CURB AND GUTTER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Maryland State Highway Administration (MDSHA) Standard Specifications for Construction and Materials, issued January 2001, with all of the latest addenda, are to be used for this section, except as modified herein.

B. MDSHA Book of Standards for Highway and Incidental Structures, Current Set.

1.2 SUMMARY

A. The work covered by this Section includes the furnishing of all material and equipment and the performing of all labor to complete the construction of combination concrete curb and gutter of various types as shown on the Contract Drawings and as herein specified or directed by the Engineer.

PART 2 - PRODUCTS.

2.1 GENERAL

A. All materials for combination concrete curb and gutter shall be in accordance with MDSHA Standard Specifications Section 602.02.

PAER 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall construct combination concrete curb and gutter in accordance with MDSHA Standard Specifications Section 602.03.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. Combination concrete curb and gutter will be measured by the linear foot in accordance with MDSHA Standard Specifications Section 602.04.

B. Transitional combination concrete curb and gutter will be measured for payment as the combination concrete curb and gutter type with the greater curb height.

PART 5 - PAYMENT

5.1 BASIS OF PAYMENT

A. Combination concrete curb and gutter will be paid for at the Contract unit price bid per linear foot for each type in accordance with MDSHA Standard Specifications Section 602.04. Payment will be made under:

Item 321340-1	Mod. Type A Combination Conc. Curb & Gutter--per linear foot
Item 321340-2	Mod. Type D Combination Conc. Curb & Gutter--per linear foot
Item 321340-3	Std. Type C Combination Conc. Curb & Gutter--per linear foot

END OF SECTION 321340

SECTION 321350 – WHEEL STOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Maryland State Highway Administration (MDSHA) Standard Specifications for Construction and Materials, issued January 2001, with all of the latest addenda, are to be used for this section, except as modified herein.

B. MDSHA Book of Standards for Highway and Incidental Structures, Current Set.

1.2 SUMMARY

A. The work covered by this Section includes the furnishing of all material and equipment and the performing of all labor to furnish and install precast concrete wheel stops as shown on the Contract Drawings and as herein specified or directed by the Engineer.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials for precast concrete wheel stops shall be in accordance with MDSHA Standard Specifications Section 608.02.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall install precast concrete wheel stops in accordance with MDSHA Standard Specifications Section 608.03.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. Precast concrete wheel stops, satisfactorily installed and accepted, will be measured on a per each basis.

PART 5 - PAYMENT

5.1 BASIS OF PAYMENT

A. Precast concrete wheel stops will be paid for at the Contract unit price bid per each in accordance with MDSHA Standard Specifications Section 608.04. Payment will be made under:

Item 321350-1 Precast Concrete Wheel Stop--per each

END OF SECTION 321350

SECTION 321360 – SIDEWALKS, ENTRANCES AND APRONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Maryland State Highway Administration (MDSHA) Standard Specifications for Construction and Materials, issued January 2001, with all of the latest addenda, are to be used for this section, except as modified herein.

1.2 SUMMARY

A. The work covered by this Section includes the furnishing of all material and equipment and the performing of all labor to complete the construction of concrete sidewalks, entrances, and aprons as shown on the Contract Drawings and as herein specified or directed by the Engineer.

1. Installation of concrete walks is included with the construction of concrete sidewalks.

2. A concrete entrance with an extended apron shall be constructed from the back of a mountable curb up to the Storage Building and Material Drying Bins.

3. Concrete aprons shall be constructed from the back of mountable and standard height curbs to function as support pads for the trash dumpsters and magnesium chloride tanks.

PART 2 - PRODUCTS.

2.1 GENERAL

A. All materials for concrete sidewalks, entrances, and aprons will be in accordance with MDSHA Standard Specifications Section 603.02.

B. Reinforcement shall be in accordance with MDSHA Standard Specifications Section 908.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall construct concrete sidewalks, entrances, and aprons will be accordance with MDSHA Standard Specifications Section 603.03.

B. Concrete entrances and aprons shall be constructed with reinforcement steel over an aggregate base as indicated on the Contract Drawings.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. Concrete entrances and aprons will be measured by the square foot in accordance with MDSHA Section 603.04.

B. Concrete sidewalks will not be measured.

PART 5 - PAYMENT

5.1 BASIS OF PAYMENT

A. Concrete entrances and aprons will be paid for at the Contract unit price bid per square foot in accordance with MDSHA Standard Specifications Section 603.04. Payment will be made under:

Item 321360-1 Concrete Entrance and Apron--per square foot

B. Concrete sidewalks shall be paid for under the contract lump sum bid pay items:

Item 01 10 10-01 Western Facility Operations Building

Item 01 10 10-02 Western Facility Police Building

C. No separate payment will be made for handicap access ramps constructed within sidewalk areas.

END OF SECTION 321360

SECTION 321500 - CELLULAR CONFINEMENT LOAD SUPPORT SYSTEM FOR ROADS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Maryland State Highway Administration (MDSHA) Standard Specifications for Construction and Materials, issued January 2001, with all of the latest addenda, are to be used for this section, except as modified herein

1.2 SUMMARY

A. The work covered by this Section includes the furnishing of all material and equipment and the performing of all labor for finish grading of the lawn and planting areas indicated on the Contract Drawings, and as herein specified or directed by the Engineer.

PART 2 – PRODUCTS

2.1 SOIL MATERIALS

A. The materials noted below shall conform to the referenced sections of the MDSHA Standard Specifications..

1. Topsoil: Sections 701 and 920.01
2. No. 7 Aggregate: Section 901.01
3. Mulch Binder: Sections 904.03 or 920.05.04
4. Fertilizer: Section 920.03.01
5. Seed: Sections 920.04.01 and 920.04.02
6. Mulch: Section 920.05.03 and 920.05.04
7. Miscellaneous: Section 920.08
8. Geotextile: Sections 921.09, Class SE

2.2 CELLULAR STRUCTURE

A. A cellular structure shall be fabricated using sheet strips of perforated, textured, high-density polyethylene (HDPE) conforming to the following table:

PROPERTY	METHOD	REQUIREMENT
Density, lb/ft^3	D 1505	58.4 - 60.2
Environmental Stress Crack Resistance, hr min	D 1693	3000
Carbon Black, % by weight	—	1.5 - 2
Thickness before Texturing, mil	D 5199	50 (+5, -10 %)
Thickness after Texturing, mil	D 5199	60 (±10 %)

1. Each strip shall have a length of 12 ± ft and a width of 6 inches HDPE used to make strips for cell walls shall carbon black shall be homogeneously distributed throughout the material.

2. The surface texturing shall be diamond shape indentations at the rate of 140 to 200 indentations/in2. The perforations shall consist of horizontal rows of 0.4 inch diameter holes on 0.75 inch centers. Horizontal rows of perforations shall be staggered and separated by 0.5 inch relative to the hole centers. The dimension from the edge of the strip to the nearest edge of perforation shall be 0.3 inch

3. The HDPE strips shall be connected in series to form a honeycomb like cellular structure, using full depth ultrasonic spot welded seams, aligned perpendicular to the longitudinal axis of the strips. Weld spacing shall be 14 ± in. The ultrasonic weld melt pool width shall not exceed 1 inch

4. When expanded, the interconnected strips shall form the walls of a flexible, three-dimensional cellular confinement structure into which aggregate can be placed. HDPE cell dimensions shall have an expanded length ranging from 8.02 to 9.65 inches and an expanded width ranging from 9.20 to 11.07 inches. The number of cells in a manufactured section may vary according to site conditions. Each expanded section shall have a minimum width of 9.2 ft and minimum length of 12 ft.

B. HDPE cell seam strength shall be uniform over the full depth of the cell.

1. Short -term seam strength shall be tested in conformance with the U.S. Army Corps of Engineers Technical Report GL-86-19, Appendix A. Minimum short-term seam peel strength shall be 480 lb.

2. A long-term seam peel strength test shall be performed for a period of 7 days minimum in a temperature controlled environment that undergoes change on a one hour cycle from room temperature to 130 F.

3. Room temperature shall be as defined in E 41.

4. Test samples shall be made by welding four HDPE strips together to produce a two cell structure. Individual welds shall be tested by cutting them from the two cell structure so that 4 inches of material exist on each side of the weld. Samples shall be cut to a 4 inch width and tested by securing one end to a stationary upper clamp and attaching a weight to the free lower end. The test sample shall support a 160 lb load for the test period.

C. The cellular confinement load support system shall include stake anchors in the form of steel J-pin stakes fabricated in conformance with the Plans and 1/2 in. staples. Steel for J-pin stakes shall conform to 909.02.

PART 3 - EXECUTION

3.1 VERIFICATION.

A. Locations and site conditions shown on the Plans for the access road with a cellular confinement load support system shall be verified by the Contractor before construction.

3.2 INSTALLATION

A. Subgrade Preparation: Subgrade soils shall be grubbed and cleared of all trees, brush, debris, and root matter. Subgrade preparation shall conform to 211.03.02.

B. Geotextile Placement. Geotextile shall be placed in conformance with 211.03.03.

C. Cellular Structure Placement: Sections of HDPE cells shall be placed within three working days of geotextile placement. Sections shall be expanded into position and anchored with steel J-pins prior to placing the No. 7 aggregate. The number and layout of the J-pins shall conform to the Plans with additional pins as required to hold the shape and specified dimensions of the expanded cell sections. The J-pin diameter and length shall be suitable to hold the expanded cell sections in tension for the subgrade condition at the site. At manholes or other obstructions, the cell section shall be stretched into position and cut out around the perimeter of the obstruction to allow the cell section to fit around the obstruction and be anchored flat on the prepared surface.

The upper surfaces of adjoining cell sections shall be flush at the joint. Interleaf sides and abut ends of adjoining cell sections. Adjoining sections shall be adequately stapled to each other. Welded edge seams shall be aligned when stapling sides of adjoining sections. Abutting sections shall be stapled at the cell wall contact point and be aligned at longitudinal center lines.

D. Placement of Infill: No. 7 aggregate shall be placed into the expanded HDPE cells to a level at least 2 inches above the top of the cell walls. The drop height of infill shall be limited to 3 feet. A front end loader may be used to place the infill provided that it only traffics over cell sections that have been filled and covered with the minimum 2 inches

of additional material. The infill material shall be compacted to a minimum density of 95 percent of the standard proctor dry density or as specified by the Engineer. The compacted aggregate surface shall be graded to a level 1 ± 1/2 in) above top of the cell walls.

E. Placement of topsoil, seed, and mulch: After the aggregate has been graded and approved by the Engineer, 4 inches of topsoil shall be placed over the surface in conformance with 701.03. After the topsoil has been graded and approved by the Engineer, seed and mulch shall be placed in conformance with 705.03 and the Contract Documents.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. Cellular confinement load support system for maintenance access roads will be measured by the square yard.

PART 5 - PAYMENT

5.1 BASIS OF PAYMENT

A. Cellular confinement load support system for maintenance access roads will be paid at the Contract unit price bid per square yard. The payment will be full compensation for all excavation and hauling, disposing offsite of excess and unsuitable materials, preparation and compaction of subgrade, grading transition slopes, installation of the support system, and for all material, labor, services, equipment, tools, and incidentals necessary to complete the work

Payment will be made under:

Item 321500-1	Cellular Confinement Load Support System for Roads--per square yard

END OF SECTION 321500

SECTION 322100 - PAVEMENT MARKINGS AND SIGNING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Maryland State Highway Administration (MDSHA) Standard Specifications for Construction and Materials, issued January 2001, with all latest addenda are to be used for this section, except as modified herein.

B. Manual on Uniform Traffic Control Devices (MUTCD).

1.2 SUMMARY

A. The work covered by this Section includes the furnishing of all material, equipment and the performing of all labor to prepare for and complete the permanent pavement striping and markings as shown on the Contract Drawings and as herein specified or directed by the Engineer.

B. The work under Section also includes the furnishing and installation of posted regulatory signs and a facility identification sign.

PART 2 - PRODUCTS

2.1 MATERIAL

A. The paint for the tracking lines, and for the parking space lines, including the hatched line areas, shall be a non-toxic, waterborne pavement marking paint (fast dry, 60 second no-track) paint. The material shall be a pigment binder emulsified in water and capable of anchoring reflective beads which are applied separately. The reflective beads shall be mixed Large Beads with Standard Beads in a three to one (3:1) ratio. The paint shall be on the pre-approved list of the National Transportation Product Evaluation Program (NTPEP) Northeast regional facility. The paint shall be manufactured by Sherwin Williams Paint Company and distributed by the Baltimore Paint and Chemical Corporation, or as approved and shall conform to MSHA Specifications 951.01. White and yellow colors, respectively, shall essentially match color chip Nos. 37886 and 33538 in Federal Standard 595 when compared instrumentally.

B. Reflective glass beads shall conform to M247, except the gradation shall conform to the following:

Gradation Sieve Size	Percentage Passing	
	Standard Beads	Large Beads
12 (1.70 mm)		100
14 (1.40 mm)		95-100
16 (1.18 mm)		80-95
18 (1.00 mm)		10-40
20 (0.85 mm)	100	0-5
30 (0.60 mm)	75-95	
50 (0.30 mm)	15-35	
100 (0.15 mm)	0-5	

Glass beads shall be colorless, clean, transparent and free of milkiness or excessive air bubbles. The refractive index shall be 1.50 to 1.52 when tested in conformance with MSMT 211. Glass beads shall be smooth, spherical in shape, free of sharp angular scars, scratches or pits and shall contain a minimum of 60 percent silica. Beads shall have a minimum average roundness of 75 percent when tested in conformance with D1155. Glass beads shall be as manufactured by Flex-O-Lite, Keyser, West Virginia or as approved equal.

C. All other pavement marking materials shall conform to MDSHA Standard Specification Section 549.02 for the products listed for payment under Part 5.

D. Materials for the signs shall conform to MDSHA Standard Specifications Section 813.02. Refer to Section 950.03.02 for the Type III reflective sheeting to be used for the sign panels.

E. Wood posts shall be furnished for the Regulatory sign installations. Refer to MDSHA Standard Specifications Section 812.02.

F. Galvanized tubular steel posts set in reinforced concrete foundations with breakaway base supports shall be supplied for the facility identification sign. Refer to MDSHA Standard Specifications Sections 801.02, 802.02, and 821.02.

PART 3 - EXECUTION

3.1 INSTALLATION OF PAVEMENT STRIPING AND MARKINGS

A. The location, width and type of striping and markings shall be as specified in this Section and on the Contract Drawings, or as directed by the Engineer. Generally, lead free reflective thermoplastic markings will be used to delineate the roadway edges and centerlines, preformed thermoplastic markings will be used for all symbols and legends, and waterborne traffic paint will be used for the tracking and parking space lines.

B. The paint shall be applied when the ambient, surface, relative humidity and paint temperatures are in conformance with the manufacturer's recommendations. Pavement surfaces shall be dry and free of glaze, oil, dirt, grease or other contaminants prior to

application of the pavement markings. Surfaces not conforming to these requirements shall be cleaned to a width equal to 2 inches wider than the width of the line. Prior to applying new pavement markings over existing markings, the application surface area shall be cleaned.

C. Applying pavement striping and markings over longitudinal joints is prohibited. They shall preferably be offset 2 inches from longitudinal construction joints.

D. The paints shall be reflectorized for night visibility by the addition of reflective beads which are applied into the surface of the wet paint by the pressurized method before it dries and sets. The reflective beads shall be mixed Large Beads with Standard Beads in a three to one (3:1) ratio.

E. The Contractor shall protect the striping and markings until dry by placing guards or warning devices as approved by the Engineer and in conformance with the Manual on Uniform Traffic Control Devices (MUTCD). In the event any vehicle crosses the wet marking, the marking shall be reapplied and any marks left on the pavement by the vehicle shall be removed. This work shall be done by the Contractor at no additional cost to the Administration.

F. The Contractor shall apply the beads uniformly across the surface of the stripe at the rate of 6 to 7 lb/gal of paint. When large type reflective beads are specified, they shall be applied uniformly across the surface of the stripe at the rate of 12 lb/gal of paint by special gravity fed bead guns conforming to the manufacturer's recommendations.

G. The paint shall be a continuous solid line applied at a wet film thickness of 14 + 1 mil.

H. The applied paint shall dry to a no-track condition within 60 seconds.

I. The retroreflectance shall be determined using a retroreflectometer supplied by the Contractor. The instrument shall have a geometry of illumination angle of 86.5 degrees and an observation angle of 1.5 degrees. The instrument shall be standardized daily in conformance with the manufacturer's recommendation. At the time of the paint application, the minimum retroreflectance values shall be 250 and 150 millicandellas/lux/square meter for white and yellow, respectively.

J. Before beginning work each day or when changing colors, the Contractor shall place a minimum of 200 ft. of paint for a test strip at a location specified by the Engineer. The test strip will be evaluated by the Engineer for distribution and bonding of beads, thickness of paint stripe, retroreflectance and dry time as specified in MSMT 729.

K. The no-track time shall not be exceeded when the pavement temperature is between 40 and 120 F and under all humidity conditions, providing the pavement is dry. The no-track time shall be determined by passing over the applied line at approximately 30 degrees with a standard passenger car or pickup truck. When viewed from a distance of 50 ft., the pavement surface shall show no evidence of the paint being picked up and

redeposited on the pavement by the vehicle. The Contractor will be authorized to proceed only if the markings on the test strip conform to the specified criteria.

L. The edges of the striping and markings shall not vary from a straight line more than ½ inch and the dimensions shall be within a tolerance of plus or minus five percent (5%).

M. The equipment used for application of the paint shall be capable of applying waterborne traffic paint which has been approved by the Engineer. The Contractor shall provide access to the paint application equipment for inspection by the Engineer. The equipment shall be approved by the Engineer prior to start of work.

3.2 INSTALLATION OF SIGNS

A. The regulatory and facility identification signs shall be mounted on wood posts firmly secured into the ground per MDSHA and MUTCD Standards for ground mounted signs. The signs shall be installed where indicated on the Contract Drawings or as directed by the Engineer. Refer to MDSHA Standard Specification Sections 801.03, 802.03, 812.03, 813.03, and 821.03.

B. Provide and install signs to identify parking spaces dedicated for use by fuel efficient vehicles and car pool vehicles in amount not less than 5% of total parking spaces required to meet facility's zoning criteria (calculated amount of spaces indicated below). Assigned spaces are to be located as close to main building entrance as design allows without conflicting with required ADA designated parking.

1. For fuel efficient vehicles, provide two parking spaces and signs. Signs (18" x 12") to read "Fuel Efficient Vehicle Parking Only."

2. For car pool vehicles, provide two parking spaces and signs. Signs (18" x 12") to read "Reserved for Car Pool."

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. 5-Inch White, and 24-inch white Lead Free Reflective Thermoplastic Pavement Marking Lines, and 5-Inch White Waterborne Traffic Paint Lines applied to the surface shall be measured by the linear foot.

B. White Preformed Thermoplastic Pavement Markings for Symbols and Legends applied to the surface shall be measured by the square foot.

C. Wood sign supports shall be measured by the linear foot.

D. Signs shall be measured by the square foot.

E. Galvanized tubular steel posts shall be measured by the linear foot.

F. Concrete foundations for signs shall be measured by the cubic yard.

G. Breakaway base supports shall be measured on a per each basis.

PART 5 - PAYMENT

5.1 BASIS OF PAYMENT

A. Payment for the pavement marking and signing items noted below, accepted as complete in place, shall be made at the Contract unit prices bid. Payment shall be considered full compensation for all the work described in this Section and shown on the Contract Drawings, and shall include all labor, materials, services, and equipment necessary to complete the work in every respect to the satisfaction of the Engineer.

B. The payment for pavement markings shall include surface preparation.

C. Payment shall be made under:

Item 322100-1	5-Inch White Lead Free Reflective Thermoplastic Pavement Marking Lines--per linear foot
Item 322100-2	5-Inch Yellow Lead Free Reflective Thermoplastic Pavement Marking Lines--per linear foot
Item 322100-3	24-Inch White Lead Free Reflective Thermoplastic Pavement Marking Lines
Item 322100-4	5-Inch White Waterborne Traffic Paint Lines--per linear foot
Item 322100-5	White Preformed Thermoplastic Pavement Markings for Symbols and Legends--per square foot
Item 322100-6	Wood Sign Posts, 4-inch x 40 inch--per linear foot
Item 322100-7	Sheet Aluminum Signs --per square foot
Item 322100-8	Galvanized Tubular Steel Post, 4" x 4" x 3/16"--per linear foot
Item 322100-9	Concrete Foundation for Sign--per cubic yard
Item 322100-10	Breakaway Base Support System--per each

END OF SECTION 322100

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SECTION 323113 - CHAIN LINK SECURITY FENCE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Maryland State Highway Administration (MDSHA) Standard Specifications for Construction and Materials, issued January 2001, with all of the latest addenda, are to be used for this section, except as modified herein.

1.2 SUMMARY

A. The work covered by this Section includes the furnishing of all material and equipment and the performing of all labor to complete the installation of security fencing and gates at locations shown on the Contract Drawings and as herein specified or directed by the Engineer.

1.3 REFERENCED DOCUMENTS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1. American Society for Testing and Materials (ASTM):

ASTM A 47	Ferritic Malleable Iron Castings
ASTM A 53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
ASTM A 90	Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
ASTM A 120	Pipe Steel, Black and hot-dipped Zinc-coated (Galvanized) Welded and Seamless, for Ordinary Uses
ASTM A 121	Zinc-Coated (Galvanized) Steel Barbed Wire
ASTM A 123	Zinc (Hot Galvanized) Coatings of Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, bars and Strips
ASTM A 123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 392	Zinc-Coated Steel Chain Link Fence Fabric
ASTM A 428	Weight of Coating of Aluminum – coated Iron or Steel Articles
ASTM A 491	Aluminum Coated Steel Chain Link Fence Fabric
ASTM A 570	Structural Steel, Sheet and Strip, Carbon, Hot-Rolled

ASTM A 585	Aluminum-Coated Steel Barbed Wire
ASTM A 641	Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A 780	Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 817	Metallic-Coated Steel Wire for Chain Link Fence Fabric
ASTM B 117	Operating Salt Spray (Fog) Apparatus
ASTM B 429	Aluminum – Alloy Extruded Structural Pipe and Tube
ASTM D 1735	Testing Water Resistance of Coatings Using Water Fog Apparatus
ASTM F 552	Terminology Relating to Chain Link Fencing
ASTM F 567	Installation of Chain Link Fence
ASTM F 1043	Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework
ASTM F 1184	Industrial and Commercial Horizontal Slide Gates
ASTM B 221	Aluminum And Aluminum-Alloy Extruded Bar, Rods, Wires, Shapes And Tubes

2. American Association of State Highway and Transportation Officials (AASHTO):

AASHTO M 181	Chain-Link Fence

1.4 SUBMITTALS

A. Fencing Materials

1. Manufacturer's certification(s).

2. Drawings showing plan layout, grid, spacing of components, accessories, fittings, and anchorages.

B. Certifications shall show the appropriate AASHTO/ASTM test(s) for each material and a statement that the material meets the specification requirement.

PART 2 – PRODUCTS

2.1 FENCING MATERIAL

A. Existing Materials: Existing fencing materials shall not be re-used.

B. Posts and Gate Frames

1. Posts and gate frames shall be cylindrical, no circumferential welds, galvanized steel pipe conforming to ASTM A 53.

2. Galvanize material per ASTM A 123, (1.8 ounces per square foot)

3. Posts shall be sized as follows:

   a. Terminal Posts (End, Pull, and Corner Posts) – 2.875 inch OD (5.79 lb/ft)

   b. Line Posts – 2.375 inch OD (3.65 lb/ft)

   c. Gate Posts – 6.625 inch OD (18.97 lb/ft)

C. Fabric

1. Fabric shall be 2-inch mesh woven from No. 9 gauge wire conforming to AASHTO M 181.

2. The ends of the fabric shall have a knuckle selvage at the bottom and a barbed selvage at the top.

3. Aluminize material per ASTM A 491- 6 & 9 ga., aluminum coating after weaving (0.4 ounces per square foot) [wire spec. A817-83].

D. Barbed Wire:

1. Barbed wire shall be aluminum coated steel conforming to ASTM A 585, Type II.

E. Tension Wire

1. Aluminum coated steel wire, seven (7) gauge diameter core wire with tensile strength of 75,000 psi.

F. Hog Rings

1. Hog rings shall be number twelve (12) gauge steel wire

2. Galvanize material per ASTM A 641, Class 3 (0.9 ounces per square foot).

G. Wire Fabric Ties

1. Ties shall be No. 9 gauge steel wire.

2. Galvanize material per ASTM A 641, Class B3 (0.8 ounces per square foot).

H. Flat Band Fabric Ties

1. Ties shall be 1/2-inch by 0.06-inch steel.

2. Galvanize material per ASTM A 153, Class B3 (1.3 ounces per square foot).

I. Stretcher Bars

1. Stretcher bars shall be 3/16-inch by 3/4-inch high carbon steel.

2. Galvanize material per ASTM A 153, Class B1 (2 ounces per square foot).

J. Truss and Brace Rods

1. Truss and brace rods shall be 3/8-inch steel.

2. Galvanize material per ASTM A 153, Class B1 (2 ounces per square foot).

K. Turnbuckles

1. Turnbuckles shall be wrought iron per ASTM A 47 drop forged steel.

2. Galvanize material per ASTM A 153, Class A (2 ounces per square foot).

L. Gate Hinges

1. Hinges shall be malleable iron per ASTM A 47.

2. Galvanize material per ASTM A 153, Class A (2 ounces per square foot).

M. Locking Devices

1. Locking devices shall be galvanized malleable iron per ASTM A 47.

2. Plunger bars may be tubular or bar steel.

3. Galvanize material per ASTM A 153, Class A (2 ounces per square foot).

N. Stretcher Bands

1. Stretcher bands shall be 1/8-inch by 1-inch ASTM A 123, Class A steel with beveled edges.

2. Galvanized material per ASTM A 153, Class B1 (2 ounces per square foot).

O. Nuts and Bolts

1. Nuts and bolts shall be ASTM A 307 steel.

2. Galvanize materials per ASTM A 153, Class C (1.25 ounces per square foot).

P. Sleeves

1. Sleeves shall be 1.695-inch I.D. by 0.078-inch wall, drawn tube, 6 inches long. Sleeve shall be self centering type per ASTM A 53.

2. Galvanize material (1.8 ounces per square foot).

Q. Top Rails and Brace Rails

1. Rails shall be 1-1/4-inch ASTM A 53, American Standard Schedule 40 pipe.

2. Galvanize material per (1.8 ounces per square foot).

R. Rail, Brace Ends, and Post Caps for Attaching Barbed Wire Extension Arm

1. Rail, brace ends, and posts caps shall be permanent mold casting, sand casting, galvanized malleable iron per ASTM A 47.

2. Galvanize material per ASTM A 153, Class A (2 ounces per square foot).

S. Post Tops

1. Post tops shall be permanent mold, sand mold, die castings, malleable iron per ASTM A 47.

2. Galvanize material per ASTM A 153, Class A (2 ounces per square foot).

T. Barbed Wire Supporting Arm:

1. Arms for support of three (3) strands of barbed wire shall be set at an approximate 45 degree angle to slope to the outside.

2. The arms shall be fabricated to withstand a weight of 200 pounds applied at the outer strand barbed wire.

3. Barbed wire supporting arms shall be 16 gauge steel per ASTM A 570.

4. Galvanize material per ASTM A 153, Class B1 coating (2 ounces per square foot) after fabrication and with the arm at 45 degrees.

5. The top wire of the 3 wires shall be 12 inches horizontally from the fence line and the other wires spaced uniformly between top of fence fabric and the outside strand.

2.2 CONCRETE

A. All concrete for footings and ground anchors shall be Mix No. 2 in accordance with MDSHA Standard Specification Section 902.10.03.

PART 3 – EXECUTION

3.1 SECURITY FENCE INSTALLATION

A. Install new fence posts. All posts shall be set in concrete footings and spaced at 10-foot centers maximum with a tolerance of minus 2 feet. The top surface of all foundations shall be finished smooth and tapered to prevent ponding of water at the fence post. Spacing of posts shall be as uniform as practical. Each post shall be placed erected plumb and the posts shall line up horizontally as shown on the plans. Minimum dimensions of cylindrical concrete footings shall be:

	Minimum Diameter	Minimum Depth
Terminal Post	12"	3'-6"
Line Post	10"	3'-3"
Gate Post	24"	4'-6"

B A brace rail shall be installed between each terminal post and each adjacent line post along with a truss rod and turn buckle attachment.

C. Tension wire shall be provided along the top and bottom of the fence.

D. Attach new chain link fence fabric in place by securing one end to an end post corner, pull or gate post and applying sufficient tension to remove all slack before making other attachments.

1. Secure fabric to end, corner pull and gate post including vertical gate frame members using stretcher bars attached to posts with tension bands at a maximum spacing of 14 inches.

2. Secure fabric to all line posts and horizontal gate frame members with a double wrap and triple twist of tie wire at maximum spacing of 14 inches.

3. Secure fabric to tension wires with hog rings at a maximum spacing of 2 feet.

E. The security fence shall be erected at the locations shown on the Contract Drawings and approved by the Engineer to a grade conforming to existing ground contour with tolerances as shown on the drawings. The fence shall be true to line, taut and shall comply with the best practice for chain link fence construction. The bottom of the fabric shall be placed a normal distance of 1-inch above the ground line; however, over, irregular ground, a minimum clearance of 1-inch and a maximum clearance of 3 inches will be permitted for horizontal distance not to exceed 8 feet. Any excavation and backfilling required in order to comply with these provisions shall be made as directed by the Engineer. Fence fabric shall be placed on the road or adjacent property sides of posts.

F. Ensure lease lines are verified and clearly established.

3.2 GATE INSTALLATION

A. Verify areas to receive gates are completed to final grades and elevations.

B. Swing gates shall be complete with center-plug rod for double swing gates, hinges, locking devices, latches, stops, stretcher bars, truss rods, caps fasteners, and satisfactory means of padlocking to make a complete installation.

1. Hinges shall not twist nor turn under action of the gate.

2. Arrange hinges so that closed gate cannot be lifted off its hinges to obtain entry.

3. Gates shall have a 180-degree full swing.

C. The electrically operated cantilevered sliding gate shall conform to the details indicated on the Contract Drawings.

1. The gap between closed gate ends of the gate leafs shall be established as per the manufacturer's recommendations before installation of the gate posts.

2. Smooth continuous movements of both sliding gate leafs shall occur both before and after installation of the electrical gate opening controls.

3. The top rails of the gate leafs shall remain level during opening and closing operations.

PART 4 – MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. The security fencing with barbed wire shall be measured by the linear foot from the centers of all line and terminal posts up to the gate openings. The gates shall be measured on a per each basis.

PART 5 – PAYMENT

5.1 BASIS OF PAYMENT

A. Payment for the chain link security fence shall be full compensation for furnishing and installing all parts related to the fence including line and terminal posts, footings, fabric, rails, rods, fittings, brackets, barbed wire, and all appurtenances.

Payment will be made under:

Item 323113-1 8-Foot Chain Link Security Fence – per linear foot

B. Payment for the swing gates shall be full compensation for furnishing and installing all parts related to the gates including the gate posts, footings, fabric, rails, rods, fittings, hinges, brackets, barbed wire, and all appurtenances.

Payment will be made under:

Item 323113-2 12-Foot Wide Dual Leaf Swing Gate--per each

Item 323113-3 6-Foot Wide Single Leaf Swing Gate--per each

C. Payment for the electrically operated cantilevered sliding gate shall be full compensation for furnishing and installing all parts related to the gates including the gate posts, footings, fabric, rails, rods, fittings, brackets, barbed wire, roller assemblies and track rails, the electrical controls, wiring and connections, and all appurtenances.

Payment will be made under:

Item 323113-4 30-Foot Wide Dual Leaf Cantilevered Slide Gate, Electrical--per each

D. Payment for cast-in-place concrete for fence and post footings, complete in place, shall be included in and covered by the Contract unit prices bid for the respective fence and gate posts requiring the concrete footings.

E. The above prices shall include all the work described in this Section and shown on the Contract Drawings, including all labor, materials, services, equipment, tools, and incidentals necessary to complete the work in every respect to the satisfaction of the Engineer.

END OF SECTION 323113

SECTION 329300 - EXTERIOR PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Maryland State Highway Administration (MDSHA) Standard Specifications for Construction and Materials, issued January 2001, with all of the latest addenda, are to be used for this section, except as modified herein.

B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Plants.

2. Planting soils.

B. Related Sections:

1. Division 31 Section "Site Clearing" for protection of existing trees and plantings, topsoil stripping and stockpiling, and site clearing.

2. Division 31 Section "Earth Work" for excavation, filling, and rough grading and for subsurface aggregate drainage and drainage backfill materials.

1.3 ALLOWANCES

A. Allowances for plants are specified in Division 01 Section "Allowances."

1. Perform planting work under quantity allowances and only as authorized. Authorized work includes work required by Drawings and the Specifications and work authorized in writing by Architect.

2. Notify Landscape Architect weekly of extent of work performed that is attributable to quantity allowances.

3. Perform work that exceeds quantity allowances only as authorized by Change Orders.

B. Furnish trees as part of tree allowance.

1.4 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Division 01 Section "Unit Prices."

1. Unit prices apply to authorized work covered by quantity allowances.

2. Unit prices apply to additions to and deletions from Work as authorized by Change Orders.

1.5 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than sizes indicated wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

C. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

D. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.

E. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.

F. Finish Grade: Elevation of finished surface of planting soil.

G. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

H. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

I. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

J. Planting Area: Areas to be planted.

K. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

L. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

M. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

N. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

O. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

P. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

Q. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.6 SUBMITTALS

A. Product Data: For each type of product indicated, including soils.

1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.

2. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to the Project.

3. Plant Photographs: Include color photographs in digital 3- by 5-inch format of each required species and size of plant material as it will be furnished to the Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

B. Samples for Verification: For each of the following:

1. Trees and Shrubs: Three samples of each variety and size delivered to the site for review. Maintain approved samples on-site as a standard for comparison.

2. Organic Mulch: 1-pint (0.5-liter) volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.

3. Mineral Mulch: 2 lb (1.0 kg) of each mineral mulch required, in sealed plastic bags labeled with source of mulch. Sample shall be typical of the lot of material to be delivered and installed on the site; provide an accurate indication of color, texture, and makeup of the material.

C. Qualification Data: For qualified landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

D. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:

1. Manufacturer's certified analysis of standard products.

2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

E. Material Test Reports: For existing in-place surface soil and imported topsoil.

F. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before start of required maintenance periods.

G. Warranty: Sample of special warranty.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful establishment of plants.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.

2. Experience: Five years experience in landscape installation in addition to requirements in Division 01 Section "Quality Requirements."

3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:

a. Certified Landscape Technician - Exterior, with installation specialty area(s), designated CLT-Exterior.

5. Pesticide Applicator: State licensed, commercial.

B. Soil-Testing Laboratory Qualifications: An independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of the soil.

1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.

2. The soil-testing laboratory shall oversee soil sampling; with depth, location, and number of samples to be taken per instructions from Architect. A minimum of

three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.

3. Report suitability of tested soil for plant growth.

   a. Based upon the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.

   b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

      1) Soluble Salts/Conductivity Not to exceed 500 parts per million (ppm) in soil.

D. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

   1. Selection of plants purchased under allowances will be made by Architect, who will tag plants at their place of growth before they are prepared for transplanting.

E. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

   1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.

   2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

F. Plant Material Observation: Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time

during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Landscape Architect of sources of planting materials 14 days in advance of delivery to site.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Conference must be held no less than two weeks prior to installation.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.

C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

D. Handle planting stock by root ball.

E. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.

2. Do not remove container-grown stock from containers before time of planting.

3. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly-wet condition.

1.9 PROJECT CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Interruption of Existing Services or Utilities: Do not interrupt services or utilities to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary services or utilities according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of each service or utility.

2. Do not proceed with interruption of services or utilities without Owner's written permission.

C. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: March 15 – June 1.

2. Fall Planting: September 15 – November 15.

D. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

E. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.10 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.

b. Structural failures including plantings falling or blowing over.

c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Periods from Date of Substantial Completion.

a. Trees, Shrubs, Vines, and Ornamental Grasses: 24 months.

b. Ground Covers, Biennials, Perennials, and Other Plants: 24 months.

3. Include the following remedial actions as a minimum:

a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.

b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.

c. Provide extended warranty for period equal to original warranty period, for replaced plant material.

4. At the end of the Two Year Warranty & Maintenance Period, the Contractor shall notify the Owner that the warranty and maintenance services are complete, and shall submit a final report to the Owner describing in detail the conditions of the plant material. The report shall also specifically indicate plant mortality rate, and shall include current photographs, indicating the dates taken. The Owner shall notify the Landscape Architect for a final walk-through to verify the report from the Contractor.

1.11 MAINTENANCE SERVICE

A. Initial Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.

1. Maintenance Period: 24 months from date of Substantial Completion.

B. Initial Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.

1. Maintenance Period: 24 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots will be rejected.

2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

D. Labeling: Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as shown on Drawings.

E. If formal arrangements or consecutive order of plants is shown on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

2.2 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve.

B. Aluminum Sulfate: Commercial grade, unadulterated.

2.3 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1/2-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.

2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or granular texture, with a pH range of 3.4 to 4.8.

C. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.

1. In lieu of decomposed wood derivatives, mix partially decomposed wood derivatives with ammonium nitrate at a minimum rate of 0.15 lb/cu. ft. of loose sawdust or ground bark, or with ammonium sulfate at a minimum rate of 0.25 lb/cu. ft. of loose sawdust or ground bark.

D. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.4 FERTILIZERS

A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 1 percent nitrogen and 10 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.

2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.5 PLANTING SOILS

A. Soil Mix: Soil mix shall be 2/3 existing soil (new topsoil when existing is not suitable) and 1/3 pulverized pine bark (potting grade or equal).

2.6 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Pulverized Pine Bark

2. Size Range: 3 inches maximum, 1/2 inch minimum.

3. Color: Natural.

2.7 PESTICIDES

A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.8 MISCELLANEOUS PRODUCTS

A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

B. Soil Stabilization Matting: Soil stabilization matting shall be supplied in 40-96 inch width rolls and shall consist of a machine produced mat of degradable natural or man made fibers. Matting shall be smolder resistant.

1. Matting shall have a uniform thickness and distribution of fibers throughout. The top and bottom of the matting shall be covered with a degradable, extruded plastic netting having a maximum mesh opening of 2 x 2 inches or covered on the top side with netting machine sewn or bonded on 2 inch centers along the longitudinal axis of the material. The average breaking strength of any two strands of netting shall be 5 lb. minimum. Netting shall resist degradation for a minimum of six months and a maximum of one year.

2. Staples shall be U or T shaped steel wire having minimum gauges of No. 11 and No. 8 respectively.

C. Burlap: Non-synthetic, biodegradable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.

2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.

3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.

4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Landscape Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.

D. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

E. Plant Bed Preparation:

1. Existing weed growth in planting beds shall be sprayed with glyphosate with wetting agent conforming to the Maryland Pesticide Applicator's Law and to the manufacturer's recommendations.

2. After a minimum of seven days following herbicide application and prior to secondary weed growth, all planting beds shall be mowed to a height of 1-inch. After mowing, woody material and debris shall be removed.

3. On flat areas and slopes less than 4:1, 1-inch compost, peat moss or other approved organic soil amendments shall be spread over the entire surface of the planting bed and rototilled to provide a depth of 6 inches of loose soil. After rototilling, plant beds shall be raked to provided an even planting surface, removing stones greater than 3 inches and other foreign material.

4. Plant beds on 4:1 and steeper do not require surface application sludge or rototilling.

3.3 PLANTING AREA ESTABLISHMENT

A. Loosen subgrade of planting areas to a minimum depth of 4 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply fertilizer directly to subgrade before loosening.

2. Thoroughly blend planting soil off-site before spreading.

a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.

b. Mix lime with dry soil before mixing fertilizer.

3. Spread planting soil to a depth of 18 inches but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

   a. Spread approximately one-half the thickness of planting soil over loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.

B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

C. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 EXCAVATION FOR TREES AND SHRUBS

A. Pits and Trenches: Excavate circular pits with sides sloped inward. Trim base leaving center area raised slightly to support root ball and assist in drainage. Do not further disturb base. Scarify sides of plant pit smeared or smoothed during excavation.

   1. Excavate approximately three times as wide as ball diameter for balled and burlapped stock.

   2. Excavate three times wider than root spread.

B. Subsoil removed from excavations may not be used as backfill.

C. Obstructions: Notify Landscape Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

   1. Hardpan Layer: Drill 6-inch diameter holes into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.

D. Drainage: Notify Landscape Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub pits.

E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.5 TREE, SHRUB, AND VINE PLANTING

A. Set balled and burlapped stock plumb and in center of pit or trench with top of root ball flush with adjacent finish grades.

1. Remove burlap baskets from tops of root balls and partially from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.

2. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voides and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.

B. Organic Mulching: Apply 3-inch average thickness of organic mulch. Do not place mulch within 3 inches of trunks or stems.

3.6 TREE, SHRUB, AND VINE PRUNING

A. Prune, thin, and shape trees and shrubs, if necessary, as directed by Landscape Architect.

3.7 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated.

B. Use planting soil for backfill.

C. Dig holes large enough to allow spreading of roots.

D. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

E. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

F. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.8 PLANTING AREA MULCHING

A. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Organic Mulch: Apply 3-inch average thickness of organic mulch, and finish level with adjacent finish grades. Do not place mulch against plant stems.

2. Edging: Upon completion of planting, mulch beds shall be neatly cut, tapered back to the area to be mulched.

3.9 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Pre-Emergent Herbicides (Selective and Non-Selective): Apply to tree, shrub, and ground-cover areas in accordance with manufacturer's written recommendations. Do not apply to seeded areas.

C. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.10 CLEANUP AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.

B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

C. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

3.11 DISPOSAL

A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. Planting trees, shrubs, vines and seedling stock will be measured for at the Contract unit price per each item specified in the Contract Documents. The payment will be full compensation for all tree supports, watering, during the construction period and for all material, labor, equipment, tools, and incidentals necessary to complete the work. If at any time during the Contract period any plants become unacceptable, they shall be replaced at no additional cost to the Administration.

B. Installation of annuals, perennials, fall planted bulbs, and ornamental grasses will be measured for at the Contract unit price per each item as specified in the Contract Documents. The payment will be full compensation for all plants, bulbs, initial waterings, fertilizing, replacements, seasonal maintenance, and for all material, labor, equipment, tolls, and incidentals necessary to complete the work. If at any time during the Contract period any plants become unacceptable, they shall be replaced at no additional cost to the Administration.

C. Composted Wood Chips or other approved mulching materials within the shrub beds will be measured for at the Contract unit price per square yard. The measurement will be computed on the surface area of the specified thickness before settling or as directed by the Engineer. The payment will be full compensation for all mulch, material, labor, equipment, tools and incidentals necessary to complete the work.

D. Additional Watering of Plants will be measured for during the plant establishment period at the Contract unit price per 1000 gallons of water applied to the plants.

E. Plant Relocation will be measured for at the Contract unit price per cubic foot for the specified planting pit. The payment will be full compensation for plant relocating, placing all backfill, seeding of damaged turf, ad for all material, labor, equipment, tools, and incidentals necessary to complete the work.

F. Plant Refertilization will be measured for at the Contract unit price per 1000 gallons of liquid fertilizer mixture applied to the plants in conformance with 329300.2.4. The payment will be full compensation for furnishing fertilizer, water, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

G. Two (2) Year Landscape Maintenance Agreement shall be measured on a lump sum basis for the two (2) year period of the Contract.

PART 5 - BASIS OF PAYMENT

5.1 BASIS OF PAYMENT

A. The accepted quantities of plant material, organic soil amendments, organic soil amendments, fertilizers, planting soils, mulches, pesticides, and miscellaneous products used in planting will be paid for at the Contract unit price for each or per square yard, as applicable complete in place. This price shall be full compensation for furnishing all materials and for all preparation, excavation, backfilling and placing of materials, furnishing and installation of such specials that may be required to complete the item as shown on the plans; test pit excavations, and for all labor, equipment, tools, and incidentals necessary to planting.

B. 2 Year Landscape Maintenance Agreement will be paid for at the Contract Unit bid price (Lump Sum) pro-rated for each three month period after the end of the Plant Establishment period as defined by Section 710.03.06 of the SHA Specifications. The Contractor is to submit an invoice with each three month report and include certified payroll rates. Upon review and agreement of satisfactory completion of the work invoiced, the Owner will initiate payment of the Contractor according to the Contract Document. The Contractor will not be allowed to bill separate pay items, but the Lump Sum bid for the maintenance bid item shall be all inclusive of materials, supplies, equipment, etc., necessary to perform the work.

C. Payment will be made under:

Item 329300-1	Trees, Shrubs, Vines, And Seedling Stock—per each item
Item 329300-2	Annuals, Perennials, Fall Planted Bulbs, And Ornamental Grasses—per each item
Item 329300-3	Mulching Shrub Beds—per square yard
Item 329300-4	Additional Watering—per 1000 gallons
Item 329300-5	Plant Relocation—per cubic foot
Item 329300-6	Abandoned Planting Pits—per cubic foot
Item 329300-7	Plant Refertilization—per 1000 gallons
Item 329300-8	Two (2) Year Maintenance Agreement—per lump sum

END OF SECTION 32 93 00

SECTION 329500 – STORMWATER MANAGEMENT FACILITY WITH SAND FILTER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Maryland State Highway Administration (MDSHA) Standard Specifications for Construction and Materials issued January 2001, with all of the latest addenda, are to be used for this section, except as modified herein.

1.2 RELATED SECTIONS

A. Section 311000 – Site Clearing
Section 311500 – Sediment and Erosion Control
Section 312000 – Earthwork
Section 312500 – Finish Grading for Lawns and Planting Areas
Section 334100 – Storm Drain System
Section 334600 – Underdrains
Section 321500 – Cellular Cofferdam Load Support System

1.3 SUMMARY

A. The work covered by this Section includes the furnishing of all material and equipment and the performing of all labor to construct a SWM Facility with three distinct treatment areas as shown on the Contract Drawings and as directed by the Engineer.

1. The three treatment areas, separated with riprap and gabion outlet structures, consist of a pretreatment forebay, a sand filter area, and an extended detention pond.

2. The sand filter area is intended to provide water quality functions by filtering pretreated stormwater runoff through the sand filter before releasing the water to the extended detention pond.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Standard Materials:	MSHA Std. Specification:
No. 67 Aggregate	901, Table 901 A
Underdrain Pipe, Schedule 40	905
Geotextile, Class PE/SE	921.09
Sand	AASHTO M-6
Underdrain Gravel	AASHTO M-43

2.2 UNDERDRAIN PERFORATIONS

A. PVC underdrain shall have 3/8-inch perforations at 6 inches on center, four holes per vertical row.

PART 3 – EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. The Contractor shall refer to Section 312000 and Section 315000 for construction procedures related to the excavation, embankment formation, and excavation required for the three treatment areas.

B. The sand filter facility shall not be constructed until all contributing drainage areas are stabilized. The sand filter area shall not be used for sediment control facilities.

C. It is very important to minimize compaction of both the base of the sand filter area and the required backfill. When possible, use excavation hoes to remove original soil. If sand filter area is excavated using a loader, the Contractor shall use wide track or marsh track equipment, or light equipment with turf type tires. Use of equipment with narrow tracks or narrow tires, rubber tires with large lugs, or high-pressure tires will cause excessive compaction resulting in reduced infiltration rates and is not acceptable. Compaction will significantly contribute to design failure.

Compaction can be alleviated at the base of the sand filter facility by using a primary tilling operation such as a chisel plow, ripper, or subsoiler. These tilling operations are to refracture the soil profile through the 12-inch compaction zone. Substitute methods must be approved by the Engineer. Rototillers typically do not till deep enough to reduce the effects of compaction from heavy equipment.

Rototill 2 to 3 inches of sand into the base of the sand filter facility before backfilling the required sand layer. Pump any ponded water before preparing (rototilling) base.

D. The geotextile shall be placed on the prepared subgrade and the locations shown on the construction Contract Documents with the adjacent edges overlapped a minimum of 2 feet. Damaged geotextile shall be replaced or repaired at no additional cost to the Administration in a manner acceptable to the Engineer.

E. Backfill for the sand filter facility shall be the gravel/sand placed in lifts of 12 to18 inches. No heavy equipment is allowed in the basin area. Grade with light equipment such as a compact loader or a dozer/loader with marsh tracks.

F. Underdrain systems shall be placed on a 3-foot wide section of geotextile at a minimum slope of 0.5 percent. All perforated underdrain shall be wrapped in 1/2-inch hardware cloth. Observation wells of 6-inch solid PVC pipe shall be placed at the end of the underdrain runs. Underdrain shall be backfilled with No. 67 stone.

PART 4 – MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. The Stormwater Management Facility with Sand Filter will not be measured.

B. Refer to Section 334100 for measurement of the cast-in-place riser structure and the reinforced concrete pipe culverts with end sections that enter and exit the facility.

PART 5 – PAYMENT

5.1 BASIS OF PAYMENT

A. Payment for the Stormwater Management Facility with Sand Filter within the grading limits shown on the Contract Drawings shall be made at the Contract lump sum price, complete in place. The payment will be full compensation for all applicable excavation, formulation of and compaction of embankments and backfills, sheeting, shoring, de-watering, roto-tilling, loading, hauling, storing and re-handling of material, removal and disposal of excess and unsuitable material, underdrain, underdrain cleanouts and underdrain outlet pipes, sand, stone aggregate, riprap, gabions, geotextiles, and for all material, labor, services, equipment, tools, and incidentals necessary to satisfactorily complete the work.

Payment will be made under:

Item 329500-1 Stormwater Management Facility with Sand Filter--per lump sum

B. Discharge from Underdrain: Any sediment-laden water discharged from the underdrain shall be filtered or removed from the outlet structure and is incidental to complete the work.

C. Refer to Section 334100 for payment of the cast-in-place riser structure and the reinforced concrete pipe culverts with end sections that enter and exit of the facility.

D. Riprap installed adjacent to the concrete end section for the reinforced concrete outlet pipe, including the riprap cut-off wall, will not be paid separately. It shall be included in the Contract lump sum bid for the Stormwater Management Facility with Sand Filter.

END OF SECTION 329500

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SECTION 330500 - COMMON WORK RESULTS FOR UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Pipe joining materials.
2. Transition fittings.
3. Dielectric fittings.
4. Sleeves.
5. Identification devices.
6. Grout.
7. Flowable fill.
8. Piping system common requirements.
9. Equipment installation common requirements.
10. Painting.
11. Concrete bases.
12. Metal supports and anchorages.

1.3 DEFINITIONS

A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.

B. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

C. ABS: Acrylonitrile-butadiene-styrene plastic.

D. CPVC: Chlorinated polyvinyl chloride plastic.

E. PE: Polyethylene plastic.

F. PVC: Polyvinyl chloride plastic.

G. DIP: Ductile iron pipe.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Dielectric fittings.

2. Identification devices.

3. Transition fittings.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Steel Piping Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."

2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

B. Coordinate installation of identifying devices after completing covering and painting if devices are applied to surfaces.

C. Coordinate size and location of concrete bases. Formwork, reinforcement, and concrete requirements are specified in Section 03 30 00 "Cast-in-Place Concrete."

PART 2 - PRODUCTS

2.1 PIPE JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness, unless otherwise indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.

b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements for Joining Plastic Piping:

1. CPVC Piping: ASTM F 493.

2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.2 TRANSITION FITTINGS

A. Transition Fittings, General: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

B. Transition Couplings NPS 1-1/2 and Smaller:

1. Underground Piping: Manufactured piping coupling or specified piping system fitting.

2. Aboveground Piping: Specified piping system fitting.

C. AWWA Transition Couplings NPS 2 and Larger:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Cascade Waterworks Mfg. Co.

b. Dresser, Inc.; DMD Div.

c. Ford Meter Box Company, Inc. (The); Pipe Products Div.

d. JCM Industries.

e. Smith-Blair, Inc.

f. Viking Johnson.

2. Description: AWWA C219, metal sleeve-type coupling for underground pressure piping.

D. Plastic-to-Metal Transition Fittings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Spears Manufacturing Co.

2. Description: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint or threaded end.

E. Plastic-to-Metal Transition Unions:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Colonial Engineering, Inc.

b. NIBCO INC.

c. Spears Manufacturing Co.

2. Description: MSS SP-107, CPVC and PVC four-part union. Include brass or stainless-steel threaded end. solvent-cement-joint or threaded plastic end, rubber O-ring, and union nut.

F. Flexible Transition Couplings for Underground Nonpressure Drainage Piping:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Cascade Waterworks Mfg. Co.

b. Fernco, Inc.

c. Mission Rubber Company.

d. Plastic Oddities.

2. Description: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.3 DIELECTRIC FITTINGS

A. Dielectric Fittings, General: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Capitol Manufacturing Co.

b. Central Plastics Company.

c. Epco Sales, Inc.

d. Hart Industries, International, Inc.

e. Watts Water Technologies, Inc.

f. Zurn Plumbing Products Group; Wilkins Div.

2. Description: Factory fabricated, union, NPS 2 and smaller.

   a. Pressure Rating: 150 psig minimum at 180 deg F.

   b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded ferrous.

C. Dielectric Flanges:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Capitol Manufacturing Co.

   b. Central Plastics Company.

   c. Epco Sales, Inc.

   d. Watts Water Technologies, Inc.

2. Description: Factory-fabricated, bolted, companion-flange assembly, NPS 2-1/2 to NPS 4 and larger.

   a. Pressure Rating: 175 psig minimum

   b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Kits:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Advance Products & Systems, Inc.

   b. Calpico, Inc.

   c. Central Plastics Company.

d. Pipeline Seal and Insulator, Inc.

2. Description: Nonconducting materials for field assembly of companion flanges, NPS 2-1/2 and larger.

a. Pressure Rating: 150 psig minimum.

b. Gasket: Neoprene or phenolic.

c. Bolt Sleeves: Phenolic or polyethylene.

d. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Calpico, Inc.

b. Lochinvar Corporation.

2. Description: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining, NPS 3 and smaller.

a. Pressure Rating: 300 psig at 225 deg F .

b. End Connections: Threaded.

F. Dielectric Nipples:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Perfection Corporation.

b. Precision Plumbing Products, Inc.

c. Victaulic Company.

2. Description: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining.

a. Pressure Rating: 300 psig at 225 deg F .

b. End Connections: Threaded or grooved.

2.4 SLEEVES

A. Mechanical sleeve seals for pipe penetrations are specified in Section 22 05 00 "Common Work Results for Plumbing."

B. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized, plain ends.

D. Cast-Iron Sleeves: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

E. Molded PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.

G. Molded PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.5 IDENTIFICATION DEVICES

A. General: Products specified are for applications referenced in other Division 33 Sections. If more than single type is specified for listed applications, selection is Installer's option.

B. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.

1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.

2. Location: Accessible and visible.

C. Stencils: Standard stencils prepared with letter sizes complying with recommendations in ASME A13.1. Minimum letter height is 1-1/4 inches for ducts, and 3/4 inch for access door signs and similar operational instructions.

1. Material: Brass.

2. Stencil Paint: Exterior, oil-based, alkyd-gloss black enamel, unless otherwise indicated. Paint may be in pressurized spray-can form.

3. Identification Paint: Exterior, oil-based, alkyd enamel in colors according to ASME A13.1, unless otherwise indicated.

D. Snap-on Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap-on type. Include color-coding according to ASME A13.1, unless otherwise indicated.

E. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted,. color-coded, pressure-sensitive-vinyl type with permanent adhesive.

F. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers, extending 360 degrees around pipe at each location.

G. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers, at least three times letter height and of length required for label.

H. Lettering: Manufacturer's standard preprinted captions as selected by the Engineer

I. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.

1. Arrows: Either integrally with piping system service lettering to accommodate both directions of flow, or as separate unit on each pipe marker to indicate direction of flow.

J. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive vinyl tape, at least 3 mils thick.

1. Width: 1-1/2 inches on pipes with OD, including insulation, less than 6 inches; 2-1/2 inches for larger pipes.

2. Color: Comply with ASME A13.1, unless otherwise indicated.

K. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch sequenced numbers. Include 5/32-inch hole for fastener.

1. Material: 0.032-inch- thick, polished brass or aluminum.

2. Material: 0.0375-inch-thick stainless steel.

3. Material: 3/32-inch-thick plastic laminate with 2 black surfaces and a white inner layer.

4. Material: Valve manufacturer's standard solid plastic.

5. Size: 1-1/2 inches in diameter, unless otherwise indicated.

6. Shape: As indicated for each piping system.

L. Valve Tag Fasteners: Brass, wire-link or beaded chain; or brass S-hooks.

M. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.

1. Engraving: Engraver's standard letter style, of sizes and with terms to match equipment identification.

2. Thickness: 1/16 inch, for units up to 20 sq. in. or 8 inches in length, and 1/8 inch for larger units.

3. Fasteners: Self-tapping, stainless-steel screws or contact-type permanent adhesive.

N. Plastic Equipment Markers: Manufacturer's standard laminated plastic, in the following color codes:

1. Green: Cooling equipment and components.

2. Yellow: Heating equipment and components.

3. Brown: Energy reclamation equipment and components.

4. Blue: Equipment and components that do not meet criteria above.

5. Hazardous Equipment: Use colors and designs recommended by ASME A13.1.

6. Terminology: Match schedules as closely as possible. Include the following:

   a. Name and plan number.

   b. Equipment service.

   c. Design capacity.

   d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.

7. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

O. Plasticized Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with mat finish suitable for writing.

1. Size: 3-1/4 by 5-5/8 inches.

2. Fasteners: Brass grommets and wire.

3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.

P. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in piped utility identification with corresponding designations indicated. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of piped utility systems and equipment.

1. Multiple Systems: Identify individual system number and service if multiple systems of same name are indicated.

2.6 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.

2. Design Mix: 5000-psi, 28-day compressive strength.

3. Packaging: Premixed and factory packaged.

2.7 FLOWABLE FILL

A. Description: Low-strength-concrete, flowable-slurry mix.

1. Cement: ASTM C 150, Type I, portland.

2. Density: 115- to 145-lb/cu. ft.

3. Aggregates: ASTM C 33, natural sand, fine and crushed gravel or stone, coarse.

4. Aggregates: ASTM C 33, natural sand, fine.

5. Admixture: ASTM C 618, fly-ash mineral.

6. Water: Comply with ASTM C 94/C 94M.

7. Strength: 100 to 200 psig at 28 days.

PART 3 - EXECUTION

3.1 DIELECTRIC FITTING APPLICATIONS

A. Dry Piping Systems: Connect piping of dissimilar metals with the following:

1. NPS 2 and Smaller: Dielectric unions.

2. NPS 2-1/2 to NPS 12: Dielectric flanges or dielectric flange kits.

B. Wet Piping Systems: Connect piping of dissimilar metals with the following:

1. NPS 2 and Smaller: Dielectric couplings or dielectric nipples.

2. NPS 2-1/2 to NPS 4 Dielectric nipples.

3. NPS 2-1/2 to NPS 8 : Dielectric nipples or dielectric flange kits.

4. NPS 10 and NPS 12: Dielectric flange kits.

3.2 PIPING INSTALLATION

A. Install piping according to the following requirements and Division 33 - Utilities Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on the Coordination Drawings.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping to permit valve servicing.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Select system components with pressure rating equal to or greater than system operating pressure.

I. Sleeves are not required for core-drilled holes.

J. Permanent sleeves are not required for holes formed by removable PE sleeves.

K. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of equipment areas or other wet areas 2 inches above finished floor level.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

   a. PVC Pipe Sleeves: For pipes smaller than NPS 6.

   b. Steel Sheet Sleeves: For pipes NPS and larger, penetrating gypsum-board partitions.

L. Verify final equipment locations for roughing-in.

M. Refer to equipment specifications in other Sections for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 33 - Utilities Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

G. Grooved Joints: Assemble joints with grooved-end pipe coupling with coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

H. Soldered Joints: Apply ASTM B 813 water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.

I. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

J. Pressure-Sealed Joints: Assemble joints for plain-end copper tube and mechanical pressure seal fitting with proprietary crimping tool to according to fitting manufacturer's written instructions.

K. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.

2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.

3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.

5. PVC Nonpressure Piping: Join according to ASTM D 2855.

6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

L. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

M. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

N. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End PE Pipe and Fittings: Use butt fusion.

2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.

O. Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3. Install dielectric fittings at connections of dissimilar metal pipes.

3.5 EQUIPMENT INSTALLATION

A. Install equipment level and plumb, unless otherwise indicated.

B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.

C. Install equipment to allow right of way to piping systems installed at required slope.

3.6 PAINTING

A. Painting of piped utility systems, equipment, and components is specified in Division 09 painting Sections.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 IDENTIFICATION

A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.

1. Stenciled Markers: According to ASME A13.1.

2. Plastic markers, with application systems. Install on insulation segment if required for hot noninsulated piping.

3. Locate pipe markers on exposed piping according to the following:

   a. Near each valve and control device.

   b. Near each branch, excluding short takeoffs for equipment and terminal units. Mark each pipe at branch if flow pattern is not obvious.

   c. Near locations where pipes pass through walls or floors or enter inaccessible enclosures.

   d. At manholes and similar access points that permit view of concealed piping.

   e. Near major equipment items and other points of origination and termination.

B. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of equipment.

   1. Lettering Size: Minimum 1/4 inch high for name of unit if viewing distance is less than 24 inches, 1/2 inch high for distances up to 72 inches, and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.

   2. Text of Signs: Provide name of identified unit. Include text to distinguish among multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

C. Adjusting: Relocate identifying devices that become visually blocked by work of this or other Divisions.

3.8 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

   1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.

   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of base.

3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

5. Install anchor bolts to elevations required for proper attachment to supported equipment.

6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

7. Use minimum 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Section 033000 "Cast-in-Place Concrete".

3.9 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor piped utility materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.10 GROUTING

A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. No separate measurement will be made for work under this section.

PART 5 - PAYMENT

5.1 BASIS OF PAYMENT

A. No separate payment will be made for work under this section. The cost of the work described in this section shall be included in each contract bid item.

B. Cost include all labor, materials, services, testing and equipment necessary to complete the work in every respect

END OF SECTION 330500

SECTION 330700 - FUEL STORAGE AND DISPENSING SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. The work covered by this section includes the furnishing of all materials and equipment and the performing of all labor to complete the Fuel Storage and Dispensing System as shown on the Contract Drawings and as herein specified or directed by the Engineer.

B. This work shall include, but is not limited to:

1. Installation of two 2,500 gallon capacity doublewall fiberglass underground fuel storage tanks for diesel and gasoline storage including excavation and backfilling, sheeting and shoring, dewatering, reinforced concrete ballast slab under tanks, pipe bollards, manhole frames and covers; hydrostatic tank leak monitoring system, submerged pumps, tank level and monitoring system, observation wells, overfill protection, and vent and vapor recovery piping.

2. Exterior fuel distribution containment piping system underground between fuel tanks and dispensers.

3. Fuel management system including card reader to control and provide accurate accounting of fuel dispensed.

4. Fuel service island including product fuel dispensers and accessories.

5. Miscellaneous fuel specialties and accessories outside the building.

6. All necessary inspection fees, certificates, and permits pertinent to the construction and installation of the work shall be obtained and paid for by the Contractor.

1.2 RELATED SECTIONS

A. The following sections contain requirements that relate to this section:

1. Section 31 20 00 - Earth Moving

2. Section 03 30 00 - Cast-in-Place Concrete

3. Section 09 91 13 – Exterior Painting

4. Division 26 - Electrical

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure Ratings: Except where otherwise indicated, the following are minimum pressure requirements:

1. Underground Fuel Distribution Piping: 150 psig.

2. Steel Vent, Gage, and Fill Piping: 20 psig.

3. Underground Fuel Storage Tanks: 5 psig.

4. Fuel Storage Tank, Outer (Containment) Shell Walls: 5 psig.

5. Containment Conduit Piping System, Carrier Pipe: 150 psig.

6. Containment Conduit Piping System, Containment Conduit: 5 psig.

1.4 SUBMITTALS

A. General: Submit the following shop drawings in accordance with conditions of the Contract.

1. Shop drawings for fiberglass fuel storage tanks including dimensions, location and size of openings, manway, and labels.

2. Shop drawings for the concrete fuel service island including reinforcing steel and island form.

B. Product data, including size, dimensions, capacity, pressure rating, and operating characteristics for the following:

1. Fuel tank accessories and specialty fittings.

2. Fuel tank inventory and monitoring system.

3. Fuel management system.

4. Submerged fuel pumps.

5. Manhole frames and covers.

6. Automatic tank overfill prevention valve.

7. Dual hose fuel dispensers including counterweight hose retractors, hose swivels, hose breakaway connectors, and automatic shutoff nozzles.

8. Dispenser sumps including emergency shear valve with stabilizer bar and bracket assembly.

9. Fueling island accessories including stainless steel island form, fire extinguisher, paper towel holders, weatherproof container with spill containment kit, and trash drum.

10. Observation wells.

11. Pipe warning and identification tape.

12. Static grounding receptacles.

13. Coal tar epoxy coating and wrap materials for buried steel piping.

14. Tank anchor and piping cathodic protection system.

15. Fuel distribution containment conduit piping systems.

16. Vent and vapor recovery pipe and fittings.

17. Aggregate backfill material surrounding tank.

18. Geotextile material.

19. Six-inch (6) diameter steel pipe bollards.

C. Contractor shall also submit to the Engineer for approval the following certificates and manuals:

1. Certificates of Compliance and Shop Tests.

2. Recommended Spare Parts List.

3. Maintenance, Operation, and Service Manuals.

D. Test reports specified in "Field Quality Control" article in Part 3.

E. Wiring diagrams for each item of equipment with electric power supply. Include ladder-type wiring diagrams for interlock and control wiring required for final installation. Differentiate between portions of wiring that are factory installed and portions that are field installed.

F. Maintenance data for fuel tanks and accessories, dispensers, fuel pumps, valves, fuel management, tank inventory, leak, and monitoring equipment.

1.5 QUALITY ASSURANCE

A. All work shall be accomplished in accordance with the laws, ordinances, and codes of the State of Maryland and any other local, County, or State governing body having jurisdiction and the applicable requirements of the National Fire Codes and the Maryland Department of the Environment, COMAR 26.10.

B. The entire fuel storage and distribution system shall be constructed in accordance with the Environmental Protection Agency's latest regulations.

C. Governing Standards:

1. National Fire Protection Association (NFPA 30) Flammable and Combustible Liquids Code, (NFPA 30A) Automotive and Marine Service Station Code, and (NFPA 31) Standards for Installation of Oil Burning Equipment.

2. American Petroleum Institution Publication 1615, "Installation of Underground Petroleum Storage Systems."

3. Petroleum Equipment Institute Publication PEI/RP100, "Recommended Practices for Installation of Underground Liquid Storage Systems."

D. Comply with (NFPA 70) National Electrical Code for electrical connections between wiring and electrically operated devices.

E. Listing and Labeling: Provide equipment and accessories that are listed and labeled as defined in the National Electrical Code, Article 100.

F. Product Options: Storage and dispensing system tanks and equipment, piping, and accessories are based on specific types, manufacturers, and models indicated. Equipment and other components having equal performance characteristics, made by other manufacturers, may be considered, provided deviations in dimensions, operation, and other characteristics do not change design concept or intended performance as judged by the Engineer. The burden of proof of equality of products is on the Contractor.

G. Acceptance: Upon completion of the project and before final acceptance, the Contractor shall deliver to the Engineer a statement signed by the principal officer of the contracting firm stating that the fuel storage and dispensing system installation is satisfactory and in complete accordance with the Contract Plans, Specifications, and the manufacturer's prescribed procedures and has been found to be tight and in compliance with all Federal, State, and local codes covering such installation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Lift and support fuel storage tanks only at designated lifting or supporting points. Do not move or lift tank except when tank is empty.

B. Deliver pipes with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and entrance of dirt, debris, and moisture.

C. Protect stored pipes, valves, and mechanical specialties from moisture and dirt. Elevate above ground.

D. Handle fuel dispensers according to the manufacturer's recommendations.

1.7 PROJECT CONDITIONS

A. Site Information: Subsurface conditions were investigated during the design of the project. Reports of these investigations are available for informational purposes only; data in reports are not intended as representations or warranties of accuracy continuity of conditions (between soil borings). The Authority assumes no responsibility of interpretations or conclusions drawn from this information.

1.8 COORDINATION

A. All work shall be so arranged that there will not be any delays in the proper installation and completion of any part or parts of the fuel storage system work.

B. The Contractor shall coordinate the delivery and receipt of equipment at the project site so that erection is made in proper sequence and with a minimum loss of time.

C. All equipment shall be installed in accordance with the manufacturer's recommendations. Positioning of equipment shall be performed in a manner to prevent marring, scratching, gouging, or any other damage or deformation in the equipment. The equipment shall be installed plumb, level, and true to line for proper operation, and securely anchored.

D. Coordinate with pipe material, sizes, entry locations, and pressure requirements.

E. Coordinate installation and set conduits and sleeves in poured-in-place concrete and other structural components as they are constructed.

F. Coordinate sizes and locations of concrete ballast pads and surface pads for underground fuel storage tanks.

G. Coordinate delivery of gasoline and diesel fuel with Owner.

H. Coordinate electrical requirements of actual equipment furnished with the requirements specified in Division 26 - Electrical.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials shall be new and suitable for the conditions and duties imposed upon them after installation. Where applicable, materials and equipment shall bear the approval label of the Underwriters Laboratories, Inc.

B. Each item of equipment shall have manufacturer's nameplate of corrosion resistant metal attached in a conspicuous location. Nameplate data shall include manufacturer's name, address, model number, capacity rating, and such other performance data as required to completely identify the item. The nameplate lettering shall be stamped, 1/4-inch high, upper case.

2.2 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

1. Underground Fuel Storage Tanks:

   a. Containment Solutions, Inc.

   b. Xerxes Corporation

2. Fuel Tank Piping, Specialty Fittings, and Accessories:

   a. Emco Wheaton, Inc.

   b. Enviroflex

   c. OPW Fueling Components Group, Dover Corporation

   d. Total Containment

   e. Universal Valve Company, Inc.

   f. East Jordan Iron Works, Inc.

3. Tank Leak Detection and Inventory Gauge Systems:

   a. Veeder-Root Company

   b. Containment Solutions, Inc.

4. Fuel Management System:

   a. Petro Vend, Inc.

2.3 UNDERGROUND FUEL STORAGE TANKS

A. The Contractor shall provide two 2,500-gallon capacity UL labeled double wall fiberglass underground fuel tanks with fittings as shown on the drawings. Tanks will be used to store diesel and gasoline fuels.

B. Product Storage Requirements:

   1. Each tank shall be capable of storing petroleum with specific gravity up to 1.1 and shall be chemically inert to petroleum products.

2. All primary tanks shall be individually vented to atmospheric pressure. Tank is designed for operation at atmospheric pressure only, except for use with a vapor recovery system at a pressure or vacuum of approximately 1 psi.

C. Tank Monitoring Capabilities:

1. Each fuel tank shall have a space between the primary and secondary shell walls to allow for the free flow and containment of all leaked product from the primary tank.

2. Tanks shall have an integrally mounted reservoir installed on the tank for hydrostatic monitoring. The reservoir shall be constructed of fiberglass reinforced plastic materials and warranted for 30 years against failure due to internal/external corrosion and against structural failure. Tank shall have one 4-inch NPT monitoring fitting located in the center of the reservoir.

D. Warranty:

1. Fuel Storage Tank Warranty: Submit written warranty executed by manufacturer of underground fuel storage tanks. Warranty shall include labor, equipment, and materials for repair or replacement of failed tanks with no monetary limit, provided tanks are installed according to manufacturer's instructions. Warranty shall protect Owner against structural failures to tanks, including cracking, breakup, and collapse; and failure due to external and internal corrosion when used for storage of gasoline or diesel fuel for 30 years from date of original purchase. This warranty is in addition to, and not a limitation of, other rights Owner may have against Contractor under Contract Documents.

2. Fuel Storage and Dispensing System Warranty: Installation of the fuel storage and dispensing system shall be guaranteed against failure for a period of one year after completion and date of final acceptance.

2.4 FUEL TANK ACCESSORIES

A. Anchor Straps: Provide polyester or glass fiber-reinforced plastic anchor straps for each tank shown. Straps shall be standard as supplied by the tank manufacturer.

B. Certification Plate: Underwriter's Laboratories label and Factory Mutual label shall be permanently affixed to each tank.

C. Flanged Manway: Each fuel tank shall be equipped with one 22-inch i.d. fanged manway complete with UL listed gaskets, bolts, and cover. The steel manway cover shall have five 4-inch NPT fittings welded in place.

D. Tank Fiberglass Enclosure (Piping Sump) and Sensor: Each tank shall be equipped with a 42-inch diameter watertight fiberglass turbine enclosure cemented on the secondary containment collar. The enclosure shall be furnished with a 42-inch by 30-inch reducer and a push-on fiberglass lid (32.5" OD) with two handles. The enclosure shall also be provided with field installed grommets for watertight seal as detailed on the drawings. Each tank shall include a 42-inch FRP factory installed secondary containment collar and a containment collar sensor capable of detecting a 1-inch accumulation of fluid in the enclosure. The float switch shall consist of a UL listed NEMA 4X switch (normally closed) housed in a protective casing with mounting clamp.

E. Backfill:

1. Tank bedding and backfill material must be clean, naturally rounded aggregate, particle size not less than 1/8-inch nor more than 3/4-inch in diameter. Material is commonly known as "Pea Gravel."

2. Washed and free flowing stone or gravel crushings may be used as alternate material with angular particle size not less than 1/8" or more than 1/2" in diameter. Material must meet all ASTM C 33 requirements for quality and soundness.

F. Geotextile fabric shall conform to Maryland SHA Standard Specifications for Construction and Materials, Section 921.19, Class PE, Type I.

G. Concrete for ballast and top slabs shall be minimum 4000 psi. Reinforcing steel rebars shall be sized as shown on the drawings.

H. Hydrostatic Tank Leak Monitoring System:

1. Fill annular space between primary and secondary walls of each tank with brine antifreeze solution furnished by tank manufacturer.

2. Provide tank leak monitoring reservoir sensor with auxiliary alarm contacts for remote monitoring as manufactured by Containment Solutions, Inc. or equal for tank. The monitoring sensor shall be placed into the fiberglass reservoir located at top of tank. Reservoir sensor shall include high and low level switches.

2.5 FUEL TANK INVENTORY MONITORING SYSTEM

A. Provide Containment Solutions, Inc. or Veeder-root tank level sensor to monitor liquid levels in the underground petroleum product storage tanks. The system shall consist of a tank probe and cabling between sensor and control panel located inside building and shall function as part of the fuel management system.

B. The control panel shall provide the following functions for the selected tank:

1. On-demand inventory report.

2. Automatic delivery reports.

3. Leak detect reports from remote sensors located in dispenser sumps and tank piping enclosures.

4. Programmable alarms for sudden loss, low inventory, and high water.

5. Printed reports on all of the above.

2.6 FUEL MANAGEMENT SYSTEM

A. Description: The purpose of the system is to control and provide accurate accounting of all fuel and related products being dispensed. The system, in recording each transaction shall identify the driver, the vehicle, the day and time of the transaction, and the type and amount of fuel dispensed. Access to products shall be restricted to persons holding valid cards and who perform a predetermined series of data entry operations. The system provided shall be compatible with existing Authority fuel management system currently in use at other sites and shall be capable of processing dual hose use simultaneously from the same dispenser.

B. System Equipment: The system shall be comprised of the following components:

1. The Card Reader: The card reader shall be the only piece of equipment in the system to which users shall have access. It shall provide clear and concise prompting to the user.

2. The Micro-Computer: The major control component for the system shall be a microprocessor based unit to be designed and constructed with state-of-the-art technology.

3. The Control Cabinet: The control cabinet shall be keyed accessed and located adjacent to the micro-computer cabinet. This cabinet shall house the relays through which electrical power to the pumping devices is controlled.

4. Data Terminal:

a. The data terminal shall be the device through which on-site communication with and control of the system shall be effected.

b. The data terminal shall be located inside the building and will allow authorized personnel to activate the terminal through the use of a security key.

5. Printer: The printer shall be located adjacent to the data terminal which:

a. Shall operate as an on-line device to record transaction data in real time as each fuel transaction is completed.

b. Shall operate in conjunction with the data terminal as a self-prompting device for on-site data entry and display.

6. Transaction Recorder: A transaction recording device shall be located adjacent to the data terminal and printer which:

a. Shall record all transaction data in non-volatile solid state memory such that in the event of power failure no data will be lost.

b. Shall indicate through a series of LED displays its status and operation mode for diagnostic purposes.

2.7 FUEL TANK SUBMERGED PUMPS

A. Each fuel pump shall be of submersible centrifugal type, which installs through a standard 4-inch threaded tank opening. The pump assembly shall be suitable for handling gasoline or diesel fuels.

B. The pumps shall be self-lubricating and easily removed from the storage tank without disconnecting discharge piping. The pump and motor assembly shall be readily separable from the pump column for simple field replacement of the pump and motor.

C. Impellers shall be splined to the pump shaft to provide positive non-slip rotation. Diffusers shall be tightly secured to the lower motor bearing housing to prevent rotation. The pump impellers shall be made from Celcon plastic.

D. The pump intake inlet shall be horizontal to prevent drawing sediment from the tank bottom into the pump inlet.

E. The manifold assembly shall be completely sealed against fuel leakage into the ground and exterior water leakage into the tank. The discharge outlet shall be standard 2-inch NPT. The head shall have a built-in air eliminator, line check valve, pressure relief valve, and built-in syphon nozzle and venturi, syphon check valve and the pressure test

screw. The syphon system shall be capable of drawing 25 inches of mercury vacuum through the venturi.

F. The motor shall be explosion proof, designed to operate at 208 volts, with plus or minus 10 percent voltage variation, 60 cycle, single phase, 3/4 HP, permanent split phase capacitance type, continuous duty. The motor shall have an on-winding thermal overcurrent protector. The motor shall bear the UL label.

G. The motor shall have a bayonet-type electrical connector to provide a safe explosion-proof disconnect without separating any wires. Reconnecting motor to column pipe shall use an alignment dowel pin for positive realignment of electrical connector.

H. A leak detector shall be provided with the pump. The leak detector shall be a mechanical diaphragm-operated, three position pressure sensing valve, which installs directly in a 2-inch NPT opening in the head of the submerged pump. It shall be capable of detecting any line leak downstream of the leak detector, which is greater than 3 gph.

I. All of the pump components shall be designed and assembled to facilitate disassembly and servicing from above without disrupting the discharge piping.

J. The pump shall be assembled with the pump inlet and impellers at the bottom for maximum liquid draw. The motor is to be mounted above the pump inlet, so that the motor is cooled and lubricated by the liquid flow past the motor.

K. The pumps provided shall have a pumping capacity of 38 gallons per minute at 62 TDH.

2.8 STAGE II VAPOR RECOVERY SYSTEM

A. General: The vapor recovery system provided shall be capable of capturing gasoline vapors at each of the gasoline fuel dispenser hose nozzles and returning the vapors from the vehicle fuel service island to the gasoline fuel storage tank.

2.9 FUEL PIPING SYSTEM

A. Fuel piping system shall consist of pipe, flanges, bolting, gaskets, valves, and fittings. All gaskets shall be Viton or BUNA N. The pipe threads shall be clean cut and taped with Teflon pipe thread sealant tape. Pipe dope and other types of pipe thread compounds shall not be used. Provide pipe and pipe fittings materials compatible with each other.

B. Black Steel Pipe and Fittings:

1. Black Steel Pipe: ASTM A 53, Schedule 40, Type S (seamless) or ASTM A 135 Type E (electric-resistance-welded), Grade A or B, black with threaded ends.

2. Steel Fittings: ASTM A 234, seamless and ASME B16.11, threaded type for threaded joints.

3. Steel Flanges and Flanged Fittings: ASME B16.5.

4. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150, standard pattern, with threads according to ASME B1.20.1.

5. Unions: ASME B16.39, Classes 150, malleable iron, female pattern. Include brass to iron seat, ground joint, and threads according to ASME B1.20.1.

6. Black steel pipe shall be used on all tank vent lines, at the fuel storage tanks and at the fuel dispensing islands where indicated on the drawings.

7. Buried vent piping at vent riser locations and fuel tank riser pipes shall be Schedule 40, threaded black steel pipe with 150 pound malleable iron fittings. All underground pipe and fittings including threads shall be coated with coal tar epoxy in accordance with AWWA Specification C 203. Cold applied vinyl or polyethylene tape shall be applied over the coated pipe and fittings 10 to 20 mils thick. Use an effective primer and a double wrap on fittings and threads.

C. Flexible Dual Wall Fuel Distribution Pipe:

1. Carrier pipe shall be flexible nylon lined core tubing with nylon outer jacket primary fuel distribution pipe inside flexible corrugated polyethylene containment pipe.

2. Flexible duel wall fuel distribution piping by OPW, Inc., Total Containment, Inc., or approval equal shall be used on all underground fuel supply and return piping.

D. Double Wall Fiberglass Reinforced Vent and Vapor Recovery Pipe (FRP):

1. Double wall FRP shall be manufactured by the filament wounding process using a thermosetting epoxy resin to impregnate strands of continuous glass filaments which are wound around a straight mandrel at a prescribed helix angle and under controlled tension.

2. Pipe and fittings shall be suitable for continuous operation at a pressure of 150 psi and at a sustained temperature of 150 degrees F maximum in accordance with UL 971 and ASTM D 2977. Pipe and fittings shall be listed with Underwriters Laboratories (UL) for use as a below grade petroleum products piping.

3. Double wall FRP shall be used on the underground vent and vapor recovery lines.

E. Vent Pipes Transition Sump: Polyethylene with lid as detailed on the drawings. Provide 36-inch diameter composite manhole frame and watertight cover for access to transition sump.

F. Flexible Pipe Connectors for Ferrous Piping: Stainless steel hose covered with stainless steel wire braid, with ASME B1.20.1 threaded steel pipe nipples or ASME B16.5 steel pipe flanges welded to hose.

2.10 PIPE WARNING AND IDENTIFICATION TAPE

A. All underground fuel supply, return, and vapor recovery piping shall be provided with a detectable marking tape.

B. Metallic-Lined Plastic Underground Warning Tapes: Polyethylene plastic tape with metallic core, 6 inches wide by 4 mils thick. Include solid yellow background with continuously printed caption in black letters.

1. Caption: "CAUTION - BURIED FUEL PIPING BELOW."

2.11 FUEL SYSTEM VALVES

A. Remote Emergency Pump Shear Valves: Remote pump shut-off valves at dispenser shall be 1-1/2-inch size, with cast iron top and body, BUNA-N disc, plated steel carrier, copper-nickel-chrome plated brass stem, stainless steel poppet spring. BUNA-N O-ring seal, Teflon coated I.D. brass packing unit.

B. Check Valves: 2-inch, heavy duty swing check valves shall be furnished and installed at the tank submerged pumps. The bodies shall be cast iron with brass seat rings, BUNA-N discs, and bronze caps.

C. Ball Valves: Fuel system piping isolation valves located inside tank piping enclosures shall be full port stainless steel with lever operators.

D. An automatic overfill protection system shall be furnished and installed on each tank fill pipe. The overfill protection shall be EMCO Wheaton, Model A1100, OPW Model 6150, or approved equal.

2.12 MANHOLE FRAMES AND COVERS

A. All manholes shall be heavy duty traffic bearing frames and covers rated for H-20 loading as follows:

1. Submerged Pump, Tank Inventory Level Probe and Vapor Recovery Access: Universal Model 78-4210, 42-inch diameter cast ring rain tight round manhole with diamond plate steel cover including recessed handle and 10-inch deep, 12 gauge galvanized steel skirt.

2. Hydrostatic Tank Monitoring and Tank Vapor Recovery Access: Universal Model 60-1212, 12-inch diameter cast iron manhole frame and cover with 18 gauge galvanized steel skirt.

3. Tank Fill Access: Universal Model 75CD, 5 gallon capacity spill containment manhole with cast iron frame and cover.

2.13 OBSERVATION WELLS

A. Observation wells located in opposite corners of the fuel tank hole excavation shall be constructed of 4-inch Schedule 40 PVC slotted well screen pipe. The pipe shall have a minimum/maximum slot size of .020/.025 inches with not less than 30 slots per foot and shall be screened from the bottom to within 2'-0" of the ground surface. Pipe shall be equal to EBW Model 773-200-02.

B. Install lockable well cap plug with padlock equal to EBW Model 772-4, 4-inch diameter.

C. Protect each observation well with 9-inch diameter cast iron manhole frame and cover equal to Universal Model 63-9075 and capable of withstanding H-20 loadings. Cover of manhole to be painted white with black equilateral triangle in center for identification as observation well and shall be secured to 7-1/2-inch deep galvanized steel skirt with three stainless steel flush mounted bolts. Cover shall be labeled "Observation Well."

2.14 FUEL SERVICE ISLAND AND ACCESSORIES

A. General:

1. Construct reinforced concrete fuel service island including stainless steel island forms and protective steel bollards where shown and detailed on the drawings.

2. The fuel service island shall be provided with one fire extinguisher inside a cabinet and mounted as shown on the drawings. The fire extinguisher shall be multi-purpose dry chemical UL rated 4A-60B:C, 10 lbs. capacity, enameled steel container with pressure-indicating gauge, Larsen Model MP10 or equal with surface mounted cabinet. The cabinet shall be clear anodized aluminum and shall include full glass door with aluminum frame and 180 degree operating continuous hinge and level handle.

3. Provide 10-inch deep polyethylene dispenser pans with UL listed steel mounting frame, brackets, and stabilizer bar for support of the fuel dispensers at the fuel service island as detailed on the drawings. Pump emergency shear valve shall be securely fastened to each pump box with stabilizer bar and bracket assembly.

4. Provide electrical conduits including seal-off fittings between fuel dispensers and fuel management card reader station and power/control conduits to building as detailed on the drawings.

5. Provide weatherproof "No Smoking" signs facing each bay where shown on the drawings.

6. Provide two plastic wash buckets with paper towel holder.

7. Provide one steel 55-gallon drum trash can painted with one coat of primer and two coats black epoxy paint and labeled "TRASH" with minimum 3-inch high letters.

8. Provide weatherproof container with spill containment clean-up kit.

B. Fuel Dispensers:

1. Provide UL listed commercial single product, dual hose, remote dispenser with register and totalizer, equal to Bennett Model 3900.

2. Corrosion resistant green enameled steel housing, frame and base.

3. Metered dial register with automatic reset; records individual deliveries to 999.9 gallons.

4. Dial totalizer with semi-automatic reset; records to 99,999.99 gallons.

5. Operating handle activated switch for remote pump.

6. Corrosion resistant fuel strainer.

7. Emergency shear shutoff valve (OPW Model 10-RMS, 1-1/2-inch).

8. Mounting bracket and stabilizer bar (OPW Model 10-S).

9. Hose relay control box.

10. Transaction card reader/verifier for each dispenser hose.

11. Automatic Shutoff Nozzles:

    a. Unleaded gasoline (vapor recovery type).

    b. Diesel fuel.

12. Hose swivels.

13. 16 feet of fuel resistant hose, two per dispenser at vehicle fuel service island. Unleaded - 5/8-inch; diesel - 1-inch.

14. Hose counterweight retractor and hose base swivel adapter.

2.15 FUEL STORAGE SYSTEM ELECTRICAL

A. All equipment, materials, and services necessary for the installation of electrical work required to operate the fuel storage and dispensing system shall be provided. All electrical work and equipment shall be in accordance with the National Electrical Code for hazardous location. Grounding system shall maintain grounding continuity on all metallic structures and parts in the hazardous area. Lightning protection and control of static electricity shall conform to National Fire Protection Association (NFPA) 780.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall be certified and licensed for Underground Storage Tank Installation by the Maryland Department of the Environment, Oil Control Division. The certified tank installer shall be on-site during all construction activities for this item of work.

B. Each fuel storage tank shall be installed as specified herein and in accordance with the tank manufacturer's warranty requirements. The installation shall also comply with all applicable Federal, State, and local codes and regulations, including Department of the Environment, COMAR 26.10 and the standards set forth in the "Standards of the National Fire Protection Association for the Storage and Handling of Flammable and Combustible Liquids" as set forth in NFPA 30, published by the National Fire Protection Association.

C. Sheeting and shoring and any dewatering required will be considered incidental to this item.

D. All materials and equipment shall be installed complete in a first class manner and in accordance with modern methods and practice. Any material or equipment installed which does not present an orderly and reasonably neat or workmanlike appearance shall be removed and replaced when directed by the Engineer. The removal and replacement of this work shall be done at the Contractor's expense.

E. It is the Contractor's responsibility to inspect the site and to perform any test pit investigations as might be required to verify location and depth of existing utilities and/or subsurface structures within the areas of proposed work.

F. Coordination:

1. All work shall be so arranged that there will not be any delay in the proper installation and completion of any part or parts of the fuel storage and dispensing system.

2. The Contractor shall coordinate the delivery and receipt of equipment at the project site so that erection is made in proper sequence and with a minimum loss of time.

3. All equipment shall be installed in accordance with the manufacturer's recommendations. Positioning of equipment shall be performed in a manner to prevent marring, scratching, gouging, or any other damage or deformation to the

equipment. The equipment shall be installed plumb, level, and true to line for proper operation, and securely anchored.

4. The supplier of the fuel management system shall provide interconnection wiring diagram of all system components to be used on this installation. The Contractor is responsible for providing and installing all necessary conduit and wiring between the fuel tanks, dispensers, card reader, and to all control and alarm panels located inside building in order to provide a complete operational fuel storage and dispensing system.

3.2 EXCAVATION

A. Excavation, trenching, and backfilling are specified in Section 31 20 00 - Earth Moving.

3.3 FUEL STORAGE TANK INSTALLATION

A. Inspect, test, and install fuel storage tanks according to tank manufacturer's written instructions. Use fiberglass reinforced plastic hold-down straps. Notify the Maryland Department of the Environment Oil Control Program Division at least three days prior to tank installation.

B. The Contractor shall install the new double wall fiberglass fuel storage tanks where shown on the Plans in accordance with the manufacturer's installation instructions. The installation shall be performed by a Contractor certified by the State of Maryland and trained by the tank manufacturer and shall be validated by the Contractor completing the installation checklist provided with each tank. Tank installer must certify that installation requirements were met. The Contractor shall provide the Owner with a copy of the completed checklists to be kept by the Owner for validation of the manufacturer's 30 year tank warranty against tank failure.

C. It shall be the responsibility of the Contractor to ensure that water levels in the excavation shall be maintained at the lowest practical level during installation. A sump and pump or a system of well points and pumps shall be provided by the Contractor to minimize water level in the excavation. The type of system required at the site will depend on water flow rate into the excavation. The excavation bottom shall be level, free of rocks and debris, and covered with at least 12 inches of aggregate bedding material above concrete ballast slab.

D. Following installation of tank, gravel backfilling will proceed in uniform 6-inch layers to the top of the tank. Care must be taken to ensure the placement of the material completely under the tank. Following installation of piping and monitoring equipment, backfill will be placed to finished grade.

3.4 FUEL DISPENSER INSTALLATION

A. Install two remote single product, dual hose, fuel dispensers according to manufacturer's written instructions and standards.

3.5 FUEL TANK INVENTORY MONITORING SYSTEMS INSTALLATION

A. Install tank level monitoring and fuel tank/pipe leak detection systems according to manufacturer's written instructions and as indicated. Locate alarm panel at the fuel system electrical control enclosure where indicated.

1. Fuel Storage Tanks: Install fuel level sensor probes through 4-inch opening in top of tank. Install hydrostatic tank monitor with high and low level switches for leak detection in FRP reservoir at top of tank.

2. Fuel Containment Piping: Install leak-detecting sensors in containment tank/piping sumps and in fuel dispenser pans as detailed on the drawings.

3.6 FUEL MANAGEMENT SYSTEM INSTALLATION

A. Install fuel management system in accordance with manufacturer's recommendations and as required to interface with current Authority Fuel Management System.

3.7 VALVE INSTALLATION

A. Install valves in accessible locations and protect valves from physical damage.

B. Install ball and check valves as indicated.

C. Install remote pump emergency shear shut-off valves at the base of each fuel dispenser.

3.8 FUEL PIPE INSTALLATION

A. General: Install fuel system piping and containment conduit piping systems according to manufacturer's written instructions for assembly, joining, trench preparation, and installation.

1. Install components having pressure rating equal to or greater than system operating pressure.

2. Install piping free of sags and bends.

3. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

4. Install fittings for changes in direction and branch connections.

5. Install sleeves for pipes passing through concrete and masonry walls, concrete floor slabs, and where indicated.

6. Install unions adjacent to each valve, at final connections to each piece of equipment, and elsewhere as indicated, in piping 2 inches and smaller. Unions are not required for flange devices.

7. Install dielectric fittings where piping of dissimilar metals are joined.

B. Fuel Dispenser Piping Installation

1. Storage and handling, stringing, joining, layout, and preparation for installation, cutting, tapering, bonding, curing, adapters to steel piping or flexible connectors shall be in accordance with manufacturer's instructions or recommendations.

2. Piping for distribution from the fuel storage tanks to the fuel dispensers shall be installed underground in a trench and backfilled as indicated on the drawings.

3. The trench depths and routings shown on the drawings are the most desirable and preferred but they are approximate since the exact locations of existing underground utilities are not known. Where departures from the trench depths and routings shown become necessary due to existing utilities, such departures shall be brought to the attention of the Engineer for his resolution.

4. The interiors of all fuel piping shall be inspected for damage and defects and be thoroughly cleaned of foreign matter before being installed in the trench. Fuel piping interiors shall be kept clean at all times by plugging or other approved method.

5. A minimum slope of 1/16-inch per foot is required in all underground dispenser piping, however, the maximum available slope shall be used within requirements for cover over piping and depth of tank. Pipe cover requirements are detailed on the drawings. Piping shall be installed on pre-graded compacted bed material. No support or spacing material other than the bed and backfill shall be left in contact with the piping.

6. Close, continuously threaded, steel pipe nipples shall not be used underground. Joints of steel piping shall be made up with an approved gasoline pipe compound or Teflon tape.

C. Protective Coatings for Black Steel Piping

1. Piping aboveground and inside sumps shall be painted on the exterior surfaces with one coat of primer and two coats of epoxy paint. Painting shall be as specified for the tanks.

2. Underground vent and tank riser pipe including fittings shall be coated on the exterior surfaces, including pipe threads, with coal-tar enamel, AWWA Specification C203. Spirally-wound, cold-applied vinyl or polyethylene tape shall be applied over the coated pipe and fittings 10 to 20 mils thick. Use an effective primer and a double wrap iron fittings and threads. Test for Holidays in epoxy coating on ferrous material pipes as per ASTM G 62, Section 1.2, Method A.

D. Pipe Joint Construction

1. Welded Joints: Construct joints according to AWS D10.12 "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe" using qualified processes and welding operators.

2. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Position gasket concentrically. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolt gradually and uniformly using torque wrench.

3. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.

4. Make bonding adhesive joints for Glass-Fiber-Reinforced Thermosetting Resin (RTRP) piping according to manufacturer's written instructions.

E. Flexible Containment Conduit Piping System Installation:

1. Install containment conduit piping system according to manufacturer's written instructions for assembly, joining, trench preparation, and installation.

2. Install containment conduit a minimum of 2 feet below finished grade and protect piping with pea gravel bedding surrounding conduit as detailed on the plans.

3.9 OBSERVATION WELL INSTALLATION

A. Furnish and install two permanent leak monitoring well pipes in opposing corners of each tank hole installation as shown on the plans. Monitoring pipes shall be 4 inches in

diameter and shall extend to a minimum depth of 24 inches below the bottom of the tank. Maintain a minimum of 12 inches of pea gravel backfill around the outside of the monitoring pipes. Wrap pipes with filter fabric to prevent clogging. The monitoring pipes shall be capped and protected from traffic with a 9-inch diameter cast iron manhole.

3.10 CONCRETE BASES

A. Place formwork, reinforcing, and concrete as specified in Section 03 30 00 - Cast-in-Place Concrete. Excavation floor and walls may serve as forms.

B. Construct concrete fuel service island and storage tank ballast pads of dimensions indicated. Follow tank manufacturer's setting templates for anchor bolt and tie-down locations. Use 4,000 psi, 28-day compressive strength concrete and reinforcement as specified in Section 03 30 00 - Cast-in-Place Concrete.

3.11 PAINTING AND FINISHING

A. Refer to Division 09 Section "Exterior Painting" or field-applied painting requirements.

B. Damage and Touch-Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.12 PIPE WARNING AND IDENTIFICATION TAPE INSTALLATION

A. Install continuous detectable plastic underground warning and identification tape during backfilling of excavations for each fuel tank and trenches for fuel piping. Locate tape 15 inches below finished grade, directly over piping.

3.13 FIELD QUALITY CONTROL

A. General: All testing must be done in the presence of a representative of the Engineer and advance notice of applying such tests shall be given him. If any imperfections or leaks are developed by the tests, they shall be corrected by repair or replacement of defective material as directed by the Engineer and then retested.

B. Underground Tank Test: The Contractor shall inspect and precision test the tank in accordance with the tank manufacturer's current instructions for testing. The testing of the tank must not exceed the recommendations of the tank manufacturer. Duration of test shall be not less than one hour without a measurable loss of pressure. Do not approach ends of tanks that are under rest. Tank under pressure shall not be left unattended.

C. Equipment Tests: Before starting or operating any equipment system, a thorough check shall be made to determine that equipment has been properly installed, lubricated, and serviced. Factory instructions shall be followed to see that installations have been made accordingly. Any equipment, systems, or work found deficient during tests shall be replaced or revised, to the entire satisfaction of the Engineer.

D. Piping Tests:

1. Fiberglass piping shall be tested in strict accordance with the pipe manufacturer's recommendations and instructions.

2. Steel piping shall be hydrostatically tested at 1.5 times the system pressure for at least 10 minutes. Valves in the piping system shall not be subjected to the hydrostatic test pressure. All storage tanks shall be isolated from piping subject to pressure test. The testing fluid shall be gasoline or diesel. The fuel required for testing shall be supplied by the Contractor. Should any leaks be discovered in joints or connections, the piping system shall be depressurized and pumped out to repair the defects to the satisfaction of the Engineer.

3. Test fuel distribution piping according to NFPA 31. Remake leaking joints and connections using new materials.

E. The Contractor shall provide the Engineer with a certificate of testing and inspection indicating that the complete system including piping has been precision tested in accordance with these Specifications and has been found to be tight and in compliance with all State and local codes covering such installation.

F. Fuel Management and Fuel Tank Inventory Level Monitoring System Tests:

1. Test and adjust leak detection and monitoring systems controls and devices. Replace damaged and malfunctioning controls and devices.

2. Test fuel management reader stations to ensure each dispenser pump is operating properly when activated by card insertion. Verify that report sent to office location accurately indicates the card number, quantity of fuel pumped, and any other normally transmitted data. Repeat tests until results are satisfactory and in accordance with manufacturer's installation guidelines.

G. Submit reports of tests and procedures in writing to the Engineer.

H. Instruction of Maintenance and Operations Personnel:

1. The services of qualified personnel shall be furnished for a period of not less than one day at a time approved by the Engineer to operate the entire system, make all adjustments, check all equipment, instruct Owner's operations personnel, correct any defects or deficiencies, and demonstrate to the satisfaction of the Engineer that the entire system is operating in a satisfactory manner and complies with all requirements of the drawings and specifications. This operation test shall be completed prior to the request for final inspection.

2. The Contractor shall, during the one year guarantee period and as directed by the Engineer, make any additional tests and adjustments that may be required and correct any defects or deficiencies arising from the operation of the system. Before activating system, perform these steps:

a. Open valves to full open position.

b. Fill fuel storage tanks with proper grade diesel or gasoline supplied by Owner.

c. Check leak detection and monitoring systems for proper operation.

I. Cleanup: The Contractor will be required to clean up the project site and leave it in an orderly fashion. The Contractor will be required to clean the tanks, pipes, and other fuel handling systems prior to beginning operations. The tanks, piping, and fittings shall be clean and free of significant rust scale, surfactant, biological growth, or other materials that could contaminate fuel.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. No separate measurement will be made for work under this section.

PART 5 - PAYMENT

5.1 BASIS OF PAYMENT

A. No separate payment will be made for work under this section. The cost of the work described in this section shall be included in the respective Lump Sum Bid under:

Item 011010-3 Western Facility Fuel Island--per lump sum

B. Costs include all labor, materials, services, testing and equipment necessary to complete the work in every respect.

END OF SECTION 330700

SECTION 334100 - STORM DRAIN SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Maryland State Highway Administration (MDSHA) Standard Specifications for Construction and Materials, issued January 2001, with all of the latest addenda, are to be used for this section, except as modified herein.

B. MDSHA Book of Standards for Highway and Incidental Structures, Current Set.

C. ANSI/ASTM C76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

D. ANSI/ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe using Rubber Gaskets.

E. ANSI/ASTM C507 - Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe.

1.2 SUMMARY

A. The work covered by this Section includes the furnishing of all material and equipment and the performing of all labor to complete the construction of the storm drain system as shown on the Contract Drawings and as herein specified or directed by the Engineer.

B. The work shall also include constructing an underground roof drain collection system with cleanouts that will be connected into the new storm drain inlets.

C. This work shall include but is not limited to: the furnishing and placing of storm drain pipes, excavation, sheeting and shoring, stone bedding material, formwork, reinforcing steel, concrete work, brick masonry and mortar, inlet frames and steel beams and all other work required to complete the new storm drain system. This work also includes connections into existing manholes.

1.3 SUBMITTALS

A. Submit shop drawings for the following:

1. Piping Materials.

2. Manholes and Inlets, showing all proposed pipe connections, dimension, and steel reinforcement schedule.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Storm drain pipe shall be reinforced concrete culvert pipe in accordance with ASTM Designation C-76, Class IV, Wall B or C. Type II Portland Cement shall be used in accordance with Section 03300 Cast In Place Concrete.

B. Pipe shall have "0" ring rubber gasket joints in accordance with AASHTO Designation M-198 or ASTM C-443.

C. Minimum unit length acceptable is six (6) feet, except for closure sections.

D. Rubber gaskets shall form to ASTM F477.

E. Stone bedding for drain pipes shall conform to Section 312000 – Earthwork.

F. Gray iron castings shall conform to standard specifications for Gray Iron Castings ASTM Designation A48, Class No. 30-B.

G. Manhole frames and covers and inlet frames and grates shall be ductile iron. Frames may be galvanized structural steel conforming with ASTM Designation A-242. Manhole frames and covers and inlet frames and grates shall be designed to meet more severe of the following criteria:

1. Axle load 191,000 lbs. plus 30% impact.
2. Tire 18 x 25 - 4 tires per axle at 100 psi.
3. 144 inches from centerline to centerline of interior tires.
4. 300 inches from outside to outside of outer tires.
5. Contact area of tire 725 sq. in.

OR

1. Axle load 226,000 lbs. plus 30% impact.
2. Tire 96 inches outside diameter - 48 ply rating (2 tires per axle) at 85 psi.
3. 138 inches from centerline to centerline of tires.
4. Contact area of tire 1320 sq. in.

H. Inlet steps shall conform to MDSHA Standard No. MD-383-91 and MD-383-92 as approved by the Engineer.

I. All brick shall conform to the Standard Specifications for Sewer Brick ASTM Designation C32-73 for Grade SS except as herein modified. Maximum water absorption shall be 12% individual and 9% average of 5 bricks. All brick shall be new, whole and of uniform standard size with substantially straight parallel edges and square corners. Bricks shall be of compact texture, burned hard and entirely through, tough, strong and free from injurious cracks and flaws. Bricks shall have a clear ring when struck together. No salmon brick shall be used in any part of the work. Brick shall be culled after delivery if required.

J. Concrete work shall be as specified in Section 03300 – Cast-in-Place Concrete.

K. Cement mortar shall have a 5,000 psi minimum compressive strength prepared in accordance with the manufacturer's recommendations. Cement mortar for inlet liners, manhole liners and non-load bearing applications shall conform to Section 902.11 of the MSHA Standard Specifications.

L. Structural steel shall conform to ASTM A36 and shall be galvanized in accordance with ASTM A153.

M. All ductile iron pipe and fittings shall be as per AWWA C151, Class 52.

N. Neoprene rubber gaskets for hub and spigot ductile iron pipe and fittings as per AWWA C111.

2.2 COLD WEATHER PROTECTION

A. Special precautions shall be taken in freezing or inclement weather to protect masonry against injury. If masonry is laid when the air temperature is below 40 degrees F or at any time when there is immediate danger of freezing weather, the Contractor at his own expense, shall take such precautions as the Engineer may direct to prevent injury. No masonry shall be laid upon any ground or other foundation material into which frost has penetrated.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

A. All pipe shall be carefully assembled, installed, connected and run so as to avoid interference with other pipe, conduits, structures, etc.

B. All ends of abandoned pipes shall be plugged in with concrete.

C. Only proper suitable tools and appliances for the safe convenient handling and laying of pipes and fittings shall be used. Pipe and fittings shall be carefully handled and lowered into the trench. The ends of pipes shall abut against each other in a manner that no shoulder or unevenness is present along the inside of the bottom half of the pipe line. 0" rings shall be installed in accordance with manufacturer's specifications.

D. Special care shall be taken to insure the pipes are well bedded on a solid foundation. No pipe shall be brought into position until the preceding length has been thoroughly embedded and secured in place. Bedding for pipe shall be as shown on the drawings with compacted gravel bedding.

E. Any defects due to settlement shall be made good by the Contractor at his own expense. Bell holes shall be dug sufficiently large to ensure the making of proper joints. The greatest care shall be used to secure watertightness and to prevent damage to or disturbing of the joints during the backfilling process. Special precautions shall be exercised to prevent any pipe from resting on rock.

F. Whenever a pipe requires cutting to fit into the line or to bring it to the required location, the cutting shall be done so as to leave a smooth end and without extra compensation.

G. No pipe shall be laid upon a foundation into which frost has penetrated. No pipe shall be laid when there is danger of ice forming or the penetration of frost at the bottom of the excavation unless all required precautions as to minimum length of open trench and promptness are observed.

H. Pipe shall be carefully handled to prevent damage. Length of pipe shall be handled with rubber or canvas belt slings of sufficient width to protect the pipe. Rolling or dragging the pipe over rough terrain shall be prohibited. Care shall be exercised during lowering operations to avoid damage by trench sides. Trench bottom shall be inspected for rocks, skids, welding rods and other debris that will damage the pipe.

3.2 STRUCTURES

A. The Contractor shall build inlets, manholes, encasements, cradles and other miscellaneous structures at points on the pipe lines or drains of form and dimensions shown on the drawings or as may be otherwise directed by the Engineer. All structures shall be carried up to the elevation indicated on the plans.

B. Structures shall either be cast-in-place or pre-cast concrete.

C. Channels in storm drain structures shall be built to the shape of the pipe in or out as noted on the drawings. No extra payment will be made for such channels.

D. Inlets of the type and size indicated shall be constructed complete in locations and elevations shown on the drawings. The Contractor shall construct inlets of reinforced concrete with courses of brick at the top to permit raising or lowering the grating. All required openings for pipes shall be provided for with pipes built into concrete wherever shown on the drawings or where directed. The greatest care shall be used to place and keep the pipes in proper position. The concrete work around the pipes shall be carefully performed so there shall be no openings for water to pass.

E. Inlet frames, gratings and steps shall be set by the Contractor as work progresses. Steps shall be built in all structures, inlets, manholes, etc. as shown on the drawings or as directed by the Engineer.

F. When the elevations of existing utility frames and covers do not conform to the proposed paving grades, the Contractor shall adjust and reset these structures to the new grade prior to placing the surface course. If the top layer of brick on any existing structure being adjusted is in bad condition, the Contractor shall use new bricks in the process of adjusting the frames. The Contractor is responsible for the new grade of the adjusted structures. The utility frames and covers shall be set in brick and mortar. Wood blocks or pegs will not be permitted.

G. Where connections of pipes into existing storm drain manholes are required, the required entrance cavities shall be removed cleanly. The cavities shall be squared with minimally sized openings respective to the pipe sizes, and centered on the pipe alignments. Repair the inlet walls as indicated in the MDSHA Book of Standards.

H. Special care shall be taken to make the faces of brickwork smooth and to neatly strike and tool all joints on exposed faces of the brick.

I. All material and debris resulting from the raising or replacement of existing utilities shall become the property of the Contractor and shall be disposed of off Administration property.

PART 4 – MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. New pipe culverts will be measured per linear foot in accordance with MDSHA Standard Specification Section 303.04.

B. Ductile iron pipe for roof drains will be measured complete in place per linear foot of pipe actually installed, which measurement shall be along the centerline of pipe from end to end of each completed pipe line including length of fittings.

C. Ductile iron pipe for roof drain cleanouts will be measured complete in place per each Cleanout actually installed, which per each count shall be measured from the cleanout plug at the finished grade down to the inside of the bell of the header pipe to which it connects.

D. Inlets, manholes, and miscellaneous structures, as specified in the Contract Documents, will be measured per each in accordance with MDSHA Standard Specifications Section 305.04. This shall include the nonstandard cast-in-place riser structure in the SWM Facility. There will be no additional measurement made for vertical depth of inlets and manholes that exceed the minimum depths indicated in the MDSHA Book of Standards.

E. Pipe connections into existing manholes shall not be measured.

PART 5 – PAYMENT

5.1 BASIS OF PAYMENT

A. Payment for new pipe culverts, complete in place, shall be at the contract unit price bid per linear foot in accordance with MDSHA Standard Specification Section 303.04. Payment will be made under:

Item 334100-1	15-Inch Reinforced Concrete Pipe, Class 4--per linear foot
Item 334100-2	15-Inch Reinforced Concrete Pipe, Class 5--per linear foot
Item 334100-3	18-Inch Reinforced Concrete Pipe, Class 4--per linear foot
Item 334100-4	18-Inch Reinforced Concrete Pipe, Class 5--per linear foot
Item 334100-5	24-Inch Reinforced Concrete Pipe, Class 4--per linear foot
Item 334100-6	36-Inch Reinforced Concrete Pipe, Class 4--per linear foot

B. Ductile iron pipe for roof drains shall be paid for a the contract unit price bid per linear foot which price and payment will be full compensation for all excavation, sheeting, shoring, dewatering, hauling, storing, rehandling of materials, removal and disposal of excess and unsuitable material, tamped fill, formed bed or foundation, backfilling, compaction, pipe, fittings and gaskets and for all material, labor, equipment, tools, and incidentals necessary to complete the work. Payment will be made under:

Item 334100-7	6-Inch Ductile Iron Pipe, Roof Drains--per linear foot

C. Ductile iron pipe for roof drain cleanouts shall be paid for at the contract unit price bid per each which price and payment will be full compensation for all excavation, sheeting, shoring, dewatering, hauling, storing, rehandling of materials, removal and disposal of excess and unsuitable material, tamped fill, formed bed or foundation, backfilling, compaction, pipe, fittings and gaskets and for all material, labor, equipment, tools, and incidentals necessary to complete the work. Payment will be made under:

Item 334100-8	Ductile Iron Pipe Cleanouts, Roof Drains--per each

D. Inlets, manholes, and miscellaneous structures, complete in place, shall be paid for at the Contract unit price bid per each in accordance with MDSHA Standard Specification Section 303.04. This shall include the nonstandard cast-in-place riser structure in the SWM Facility. There will be no separate payment provided for additional vertical depth of inlets and manholes that exceed the minimum depths indicated in the MDSHA Book of Standards. The Temporary Draw-Down Device attached to the Riser Structure will be paid for under Section 31 15 00. Payment will be made under:

Item 334100-9	Std. Concrete End Section, 24-Inch Pipe--per each
Item 334100-10	Std. Concrete End Section, 36-Inch Pipe--per each
Item 334100-11	Precast Std. Type S Inlet, Double Grate Tandem--per each
Item 334100-12	Precast Std. Type S Combination Inlet, Double Grate Tandem--per each
Item 334100-13	Precast Std. Type S Inlet, Single Grate--per each
Item 334100-14	Std. Double Opening Type K Inlet, Open-end Grate, NTA--per each
Item 334100-15	48-Inch Diameter Precast Manhole--per each
Item 334100-16	Cast-In-Place Riser Structure--per each

E. Pipe connections into existing manholes shall be considered incidental to the cost of installing the pipe.

F. Payment for standard concrete end sections shall include compensation for any required cut-off walls as indicated on the Contract Drawings.

END OF SECTION 334100

SECTION 334606 – UNDERDRAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Maryland State Highway Administration (MDSHA) Standard Specifications for Construction and Materials, issued January 2001, with all of the latest addenda, are to be used for this section, except as modified herein.

B. MDSHA Book of Standards for Highway and Incidental Structures, Current Set.

1.2 SUMMARY

A. The work covered by this Section includes the furnishing of all material and equipment and the performing of all labor to complete the installation of underdrains in roadway cut areas as shown on the Contract Drawings and as herein specified or directed by the Engineer.

B. The work covered under this section does not include the underdrain system to be installed within the Stormwater Management Facility. Refer to the Contract Drawings for the details of construction and materials related to this system.

PART 2 - PRODUCTS.

2.1 UNDERDRAIN MATERIALS

A. All materials for underdrains shall be in accordance with MDSHA Standard Specifications Section 306.02.

B. Underdrain pipes shall be perforated polyvinyl chloride (PVC) drain pipe meeting the requirements of MDSHA Standard Specifications Section 905.

C. Filter fabric shall be Mirafi 140, manufactured by Mirafi, Inc. or Propex 4545, manufactured by Amoco Fabrics Company, or as approved by the Engineer.

D. Stone backfill shall be crushed rock and shall conform to AASHTO M43, Size No. 57.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall construct underdrains in accordance with MDSHA Standard Specifications Section 306.03.

B. Underdrains for the access road shall be connected with underdrain outlet pipes into the inlets located at the low ends of the roadway swales near the intersection.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. Underdrains will be measured by the linear foot in accordance with MDSHA Section 306.04.

B. No separate measurement for payment shall be made for underdrain outlet pipes. These pipes will be measured as underdrains.

C. The underdrain system installed within the Stormwater Management Facility will not be measured for payment.

PART 5 - PAYMENT

5.1 BASIS OF PAYMENT

A. Underdrains will be paid for at the Contract unit price bid per linear foot in accordance with MDSHA Standard Specifications Section 306.04. Payment will be made under:

Item 334606-1 Underdrains--per linear foot

B. Refer to Section 329500 for payment of the underdrain system installed within the Stormwater Management Facility.

END OF SECTION 334606